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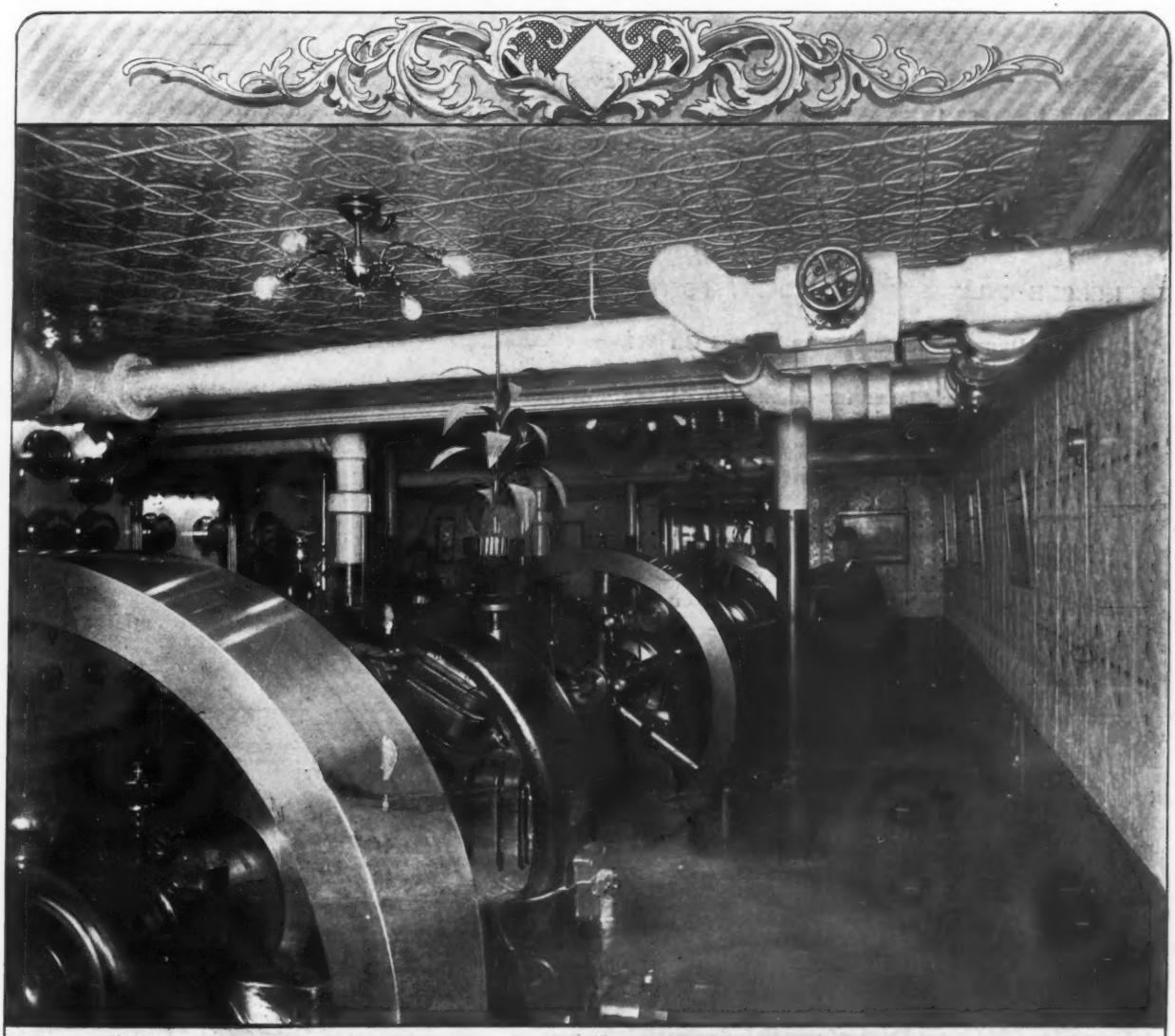

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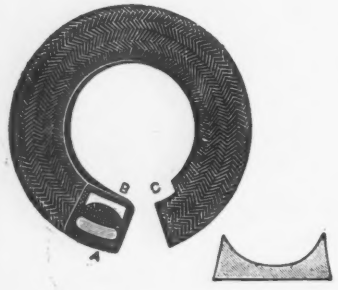

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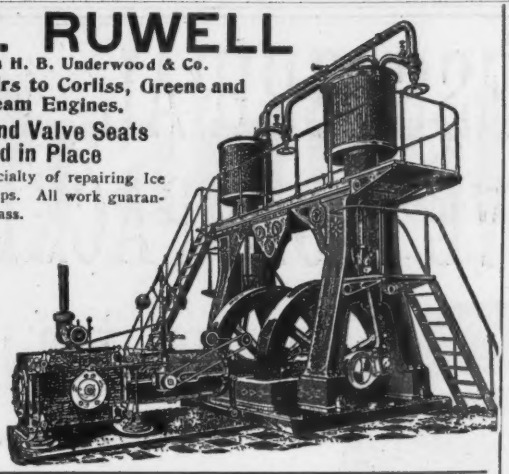

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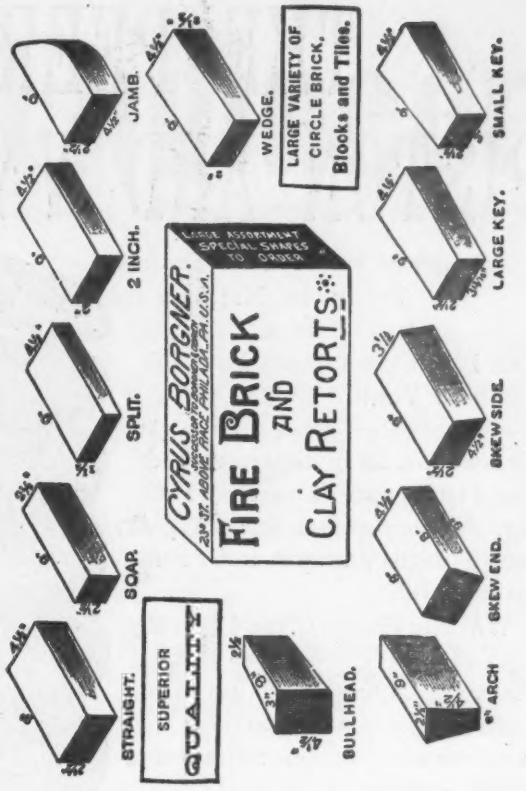

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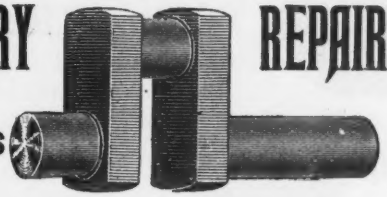

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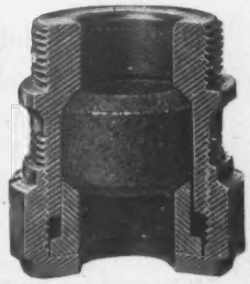

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Practical Engineer

A monthly journal, devoted to the economical generation and utilization of power and to the interests of stationary engineers

VOL. VII PHILADELPHIA, JUNE, 1903 No. 5

MAGNETOLYSIS

BY A. G. WILLIAMS.

The above title is a brand new word coined to fit a conception of the nature of the magnetic field.

Magnetolysis means the magnetic separation or decomposition of the atmosphere producing the magnetic flux displayed in the lines of force in the magnetic field.

Magnetic attraction is due to displacement of the intervening air, without which no coherence would be possible; therefore magnetism produces vacuo. The common suction pump creates a vacuum into which the water is attracted. Mechanical energy thus applied causes vacuo. No matter how exerted, force produces vacua and plena, positive and negative, or, better still, expansion and contraction. Heat is an expansive energy; cold a contractile energy.

Magnetolysis is then a contractile or squeezing force.

Electrolysis, its twin influence, is an expansive force.

Magnetism is bound electricity—Electricity is free electricity. Electricity and magnetism combined as they are in the electro-magnetic engine or dynamo is a perfect example of this peculiarity of action inherent in the stationary, inert magnet and the rapidly moving armature coils.

The residual magnetism in the electro-magnet is due to the earth's magnetism appropriated by the mass of iron forming part of the base of the machine.

The earth, as a magnet, was computed by the late Professor Gauss:

"That the total and absolute terrestrial force is equal to six magnetic steel bars of one pound each magnetized to saturation, for every cubic yard of surface, compared with one such compound bar, the total magnetism of the earth is as, 8.464, 000,-000,000,000,000,000—a most inconceivable proportion. This stupendous array of figures can only convey a faint idea of the magnetic force of the earth, but it certainly does give an idea that magnetism is inherent in all matter, iron, nickel, and cobalt are magnetic metals, because they possess the quality of storing up a greater quantity of magnetism than any other substance. Steel, or purified iron, holds it with great tenacity and parts with it slower than any other substance.

The electromagnet, as its name implies, is free electric energy concentrated on an iron bar, which is easily magnetized and as easily demagnetized on the cessation of the exciting electrical action.

As a simple and familiar example of magnetolysis or magnetic separation, I will quote from Houston and Kennelly's work on Magnetism.

"An ingenious application has been made of the ability possessed by an electromagnet to attract to it particles of iron ores in various forms of *electromagnetic ore concentrators*, the design of which is to concentrate granular ores of iron that are admixed with so large a quantity of other material as to render their smelting in the untreated condition unprofitable. Such apparatus consists essentially of powerful electromagnets so arranged that a stream of pulverized ore is permitted to fall before their poles. Under these circumstances the particles of iron are sufficiently defected from the vertical , in their downward path by the action of the magnet to permit them to fall into a compartment provided for them, while the nonmagnetic residue falls vertically into a separate heap."

With this as an illustration of magnetolysis, let us apply the same principle to magnetic action on the atmospheric gases, which are between the poles of a magnet forced with a vertical pressure of 14.7 lbs. per square inch by gravitation exactly as the iron ore.

Air is composed of magnetic and nonmagnetic gases. Nitrogen is a nonmagnetic gas, and forms four parts of the atmosphere. Oxygen is magnetic and forms one part. With these gases is admixed small quantities of water vapor, carbon dioxide and traces of ozone ammonia and acids, which are negatively magnetic and are generally known as hydrogenous vapors. This admixture of atmospheric gases is held together mechanically, or rather electro-magnetically. Atmospheric electricity or the subtle ether which fills the outside space filtrates through and fills the space between each atom, forms their bond of union. The magnetic field repulses these irons, as they are termed.

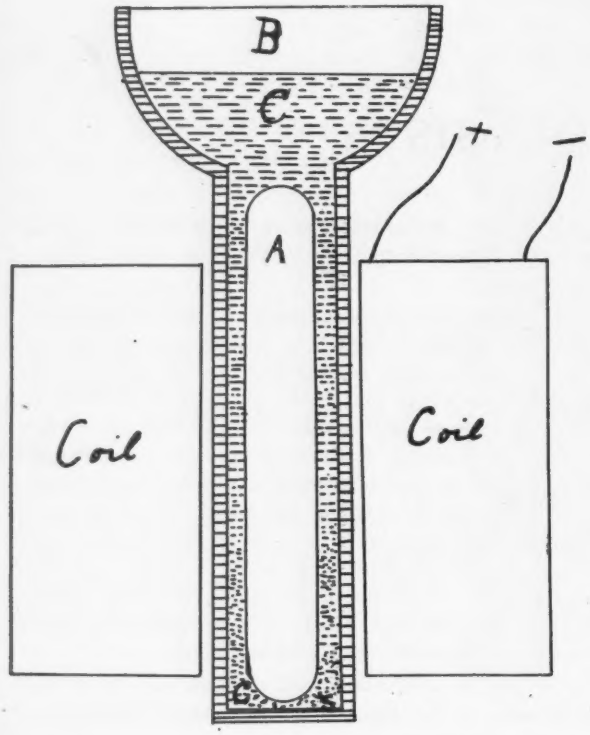
The Roentjen rays or x-rays penetrate even solid substances. The air is penetrated by x-rays, as exemplified in wireless telegraphy.

The whole universe of sun, planets and stars are in wireless communication by means of an electromagnetic space.

That magnetism does produce vacuo, I will instance a convincing proof of the argument:

Vol. VIII, *Journal of the Society of Telegraph Engineers* (England) fig. 1, page 149, an experiment by E. Chernoff.

An electromagnetic reel connected to a battery. B.B. a turned steel mould and funnel; C. C. the casting; A. the hollow core. Mr. E. Chernoff tried this experiment to note the effect of magnetism on a cooling metal. Molten steel was poured into the mould. While cooling a series of ebullitions was observed; on cooling, he found it to be hollow, the walls of the hollow core no thicker than a sheet of writing paper and so fragile that it broke. Possibly this may have been an absolute vacuo.



If the magnetic action is competent to form vacuo under these conditions, how much more so in an elastic medium like the atmosphere?

The turbine or centrifugal engine is perhaps the most perfect and certainly the fastest high speed device. A dynamo is a compound electromagnetic machine, revolving at a high rate. The armature winding rotates at right angles to the magnet coil winding.

When the dynamo is set in motion, the residual or terrestrial magnetism resists this motion. This resistance means a gradual building up of the magnetic field. Vacuum is created at every coupling contact, followed by an inrush of air which fills every void so developed; so that a dynamo revolving at a speed of 1200 revolutions per minute, in a six magnet arrangement, makes 7200 vacua and 7200 plena—7200 electrical impulses each minute. An electromagnetic flux and reflux is produced in the air gap of the magnetic field. Magnetolysis or air concentration ensues. The ether waves cut out of it, the brushes sweep off this electromotive force and force it into the conducting wires

E. M. F. always selects the path of least resistance and the incessant revolving armatures crowd it into the line wires.

A wire conveying E. M. F. is kept at a very high tension or strain. Steam, water or air in a pipe under great pressure is very much in the same condition—The slightest fault in its insulation means loss and often disaster.

Steam is lost by radiation; electricity is also lost in the same manner, but with this difference: Heat is weakened by cold; electricity is strengthened by cold. Heated air is of a lower electrostatic capacity, and in the endeavor to restore equilbris electricity is radiated and lost.

It is a remarkable fact that the electrostatic condition of the atmosphere is always higher during the prevalence of northerly winds, especially north east or trade winds. During southerly winds and especially south westerly or counter trade winds—which are always moisture laden, warm winds—it is often impossible to develop frictional electricity. Hydrogenous or water vapor (synonymous with wet steam) replace to a great extent the normal quantity of electrical charge; therefore its potential force is impaired, the air is partially and negatively magnetic, it resists the downward flow of the atmospheric electricity exactly as a cloud arrests the sun's light and heat; it also offers a great resistance to the electrical or primary force.

In this connection, as damp hot weather is inmical to electrical development, I would venture to point particularly to a very serious fault in electrical installations. Too often the dynamos are placed in dark, damp and steam-laden, heated cellars, with a resultant weak atmosphere in every sense of the word, minus oxygen, plus hydrogen, and per force weak electrostatic capacity. The dynamo has to do more work in extracting E. M. F. from the air, loss of insulation is an inevitable sequence and wasteful expenditure of force the result.

Electrical engines should be installed in dry, well ventilated and lighted rooms, not exposed to the sun's direct rays—an increased output of E. M. F. would ensue; less loss, by reason of perfect insulation at the fountain head; the air supplying the E. M. F. would be of a higher electrostatic potential, and the initial loss of energy obviated.

Electricity and magnetism are twin influences indissolubly connected—one cannot exist without the other.

The combination of the two in the form of an electromagnet is a happy union. The dynamo, however, destroys this bond by its violence, rends the twin influences in twain, the balance of gravity is upset, the twin influences struggle with terrific force for supremacy, every molecule or atom within their reach is put into violent disturbance, electrolysis is succeeded by magnetolysis; fullness by emptiness; vacua by plena

---

Gas Engine Improvement

A Feature Which Reduces Danger of Accidental Explosion. is a patent for an improvement in carburetters for gasoline engines recently issued and assigned to Joseph Hill Brinton, Philadelphia. It is designed primarily for affecting by simple and efficient mechanism a ready variation of the proportions of oil and air combined for the production of an explosive gas, as well as for regulating the rate at which the oil and air shall be combined while maintaining the predetermined ratio of combination. This is an improvement which will be appreciated by all users of this type of engine, as it overcomes the trouble from accumulation of oil in the mixing chamber of such engines, thus not only preventing the waste of oil by leakage through the air intake valve to the floor of the engine, but also avoiding the danger of external explosion. The quantity of oil supplied

to mixing chamber is regulated by a combined rotary valve and needle valve, through which the oil is fed; the quantity of air which enters the mixing chamber is regulated by a lift valve, through which the air is fed; this lift valve, together with the combined rotary valve and needle valve, are operated simultaneously by a single lever, thus enabling the operator to preserve the regular proportion of oil and air entering the mixing chamber, and also to increase or diminish the flow at will. Danger of stoppage by surcharging of the air with oil (by which the spark may fail to explode and the engine consequently stop) is thus guarded against, and the usual leakage of unvaporized oil about the engine, which frequently leads to dangerous explosions, is wholly prevented.

Ammonia Compressors

The characteristic feature of an ammonia compression system of refrigeration is to be found in the compressor. While there may be differences in detail in regard to the other parts of the system, they are in general only of secondary order. In general, similar methods of condensation and evaporation are employed. Preferences may be stated, but are not necessarily adhered to. The real differences in the various systems are to be found in the compressors.

Of course each system as carried out has its own peculiar advantage. Were this advantage unencumbered by some disadvantage it would soon monopolize the field.

The difficulties encountered are really not very numerous, though sufficiently so to give rise to considerable variety in attempting to reach the common ideal. This ideal is, of course, simply the ability to pump the greatest amount, by weight, of gas with the greatest economy of operation. It is implied in this statement that waste should be reduced to a minimum. A few difficulties stand out prominently before all the rest. First and foremost of these, is the difficulty in obtaining a perfect discharge of compressed gas from the pump. Another is liability of leak at the stuffing box. Then there is the serious matter of the heat generated during the compression.

Other difficulties there are of more or less importance. Where special means have been resorted to for overcoming any of them they may be magnified in importance; otherwise, they are more likely to be ignored. Valves and pistons receive their share of attention.

To dispose of most of these difficulties on paper is simple enough. To dispose of any of them entirely in practice is not so simple. For instance, to discharge all the gas from the cylinder, some claim to have the piston travel flush to the end of the cylinder. As a matter of fact, this is impossible. Still, it must be admitted that they come wonderfully near doing so. So, again, in regard to the remedy for leaky stuffing-boxes. To tighten the stuffing box seems to be the only self evident remedy. This is all very good. By tightening the stuffing-box the leakage may be reduced to a minimum. Unfortunately, this remedy may be so applied as to cause the power required to overcome the friction of the piston rod a maximum as compared with the power for doing useful work. A wise precaution against the difficulties with the compressor is the employment of skilled labor, and the application of the best of materials. Good construction, correct alignment, and proper adjustment are essential to good results.

Many, or in fact, most manufacturers reduce the amount of residual gas to a minimum by the method mentioned of reducing the amount of clearance to a minimum. It is easily demonstrated that the conditions that favor the most satisfactory results are a comparatively small bore cylinder with long stroke.

An interesting method of meeting or attempting to meet the difficulty is that adopted in the De La Vergne system. In general, the principle employed is to fill up the clearance space with oil. The oil is injected in quantity during the stroke. The valves are especially arranged for expelling the oil, except that filling the clearing space. The gain, however, is not as real as might be desired, as a large quantity of gas is absorbed by the oil under the high pressure, which gas is released during the return stroke, when fresh gas is admitted, interfering accordingly with the amount of gas that will be taken in. This feature is real and appreciable. Nevertheless, a combination of desirable features in connection with the oil circulating system present themselves which would seem to establish this system in a position of favor. Aside from filling up the clearance, with the qualification mentioned, and lubricating the moving parts, the oil serves to seal the stuffing box, valves and piston, and may be circulated in quantity for the purpose of taking up the heat during compression.

The objection raised to the oil separator is real, but oil must be used for lubrication in all cases, strange statements to the contrary notwithstanding. Accordingly, oil separators are indispensable features of all systems, the difference being simply of one degree.

A method of disposing of the difficulty with the stuffing-box is to use single acting cylinders. In the case of vertical cylinders, the compression is done in the upper part, the lower part being connected to the system supplying incoming gas from the evaporator. Of course, the difficulty in regard to leaky stuffing-boxes which it is desired to remedy is due to high pressure. With the single acting compressor, as mentioned, the pressure at the stuffing-box is reduced to comparatively moderate proportions, so that the matter of packing the stuffing-box ceases to be a serious problem.

With the single acting compressor the maximum compression takes place at the extreme upper portion of the cylinder only. Here is where the heat of compression accordingly is most extreme. The cool gas in the portion of the cylinder below the piston tends to keep this portion cool.

The heat of compression, which has been alluded to, must be taken care of. Where oil injection is not utilized for the purpose, a method frequently used is to provide water circulation in a water-jacket about the cylinder. A simple and effective method of accomplishing the object without auxiliary means is that used in the Linde system, by having a proper adjustment a sufficient amount of unevaporated ammonia gas is provided to produce the required amount of cooling. This idea may even becarried to such a degree that the temperature of the gas discharged from the compressor shall be very little in excess of that of the condensing water. As something cannot be attained for nothing, this result must be charged up to some account. In this case, it must be charged to the capacity of the compressor. Furthermore, this idea is apt to be resorted to by users of systems which do not claim to be its advocates. It proved very convenient in cases where the means specially provided to produce the desired cooling fail to fully come up to the demands.

The Air Supply to the Furnace

BY R. T. STROHM.

The economy of combustion in the furnace of a steam boiler depends upon the mixture of the air supply with the combustible elements. If this mixture is imperfect, either by reason of insufficient supply, or because of improper admission the result will be incomplete combustion with a consequent loss of heat. If the mingling of the gases be perfect and uniform, then the nearest possible approach to perfect combustion is reached.

As a usual thing, air is admitted to the furnace of the ordinary steam boiler through the ashpit doors. Impelled by the draft, the current of air is drawn into the ashpit and thence passes upward among the grate bars and through the bed of fuel on the grate.

There are many advantages in this method of admitting the air supply. In the first place, the air must pass through the fuel bed, and in doing this it is brought into intimate contact with the carbon element in the fuel, and as this carbon is in a highly heated or incandescent state it is in the best possible condition to unite with the oxygen of the incoming air. Furthermore, if gases are formed by the process of distillation from the fuel on the grate, the air, when admitted in sufficient quantity, will mingle with these combustible gases at the surface of the burning fuel where the full heat of the furnace is set free, and this will promote rapid and perfect union of the elements.

There is another point to be considered also. The temperature of the furnace of a steam boiler frequently reaches several thousand degrees. The grate bars, therefore, are subject, by radiation, by contact, and by conduction, to the intense heat of the furnace. By allowing the incoming air currents to rise through the grates, then, the latter are cooled to a considerable extent, while the air supply is correspondingly heated. This accomplishes a double desirable end. In the first place, it helps to lengthen the life and utility of the grates; and in the second place, it heats the air supply, so that there is less chilling when it mixes with the solid fuel or with the gaseous distillates.

However, to obtain good results when the air is thus admitted beneath the grate, several points must be observed. The fire or the bed of fuel, must not be too thick. If this be the case, there will be considerable difficulty in the passage of the air through the mass, unless an extremely strong draft is employed. And even then there is liable to be an insufficient amount admitted to support combustion properly. Such is likely to be the case where a coking bituminous coal is used, or a coal which contains much slag or fusible matter. And such a fire requires to be frequently broken up in order to permit the air to pass through.

Again, whether the fire is thick or not, the grates must be kept clean. If the clinker is allowed to gather or if the air spaces are permitted to be clogged by the fused impurities, the flow of air will be impeded and a sluggish fire will result. This means a lower furnace temperature and decreased economy of combustion because of the lack of sufficient air.

Last of all, the fire must be uniform over the entire grate surface. In this way the resistance to the passage of air will be uniform and the same amount will pass through all portions of the fire. There must be no holes or dead spots in the fire. If these are permitted, the air will be drawn through them in greater quantity than through the burning fuel and thus not only cause unequal distribution of the supply, but will also lower the furnace temperature.

To maintain a thin fire of uniform character requires close attention to business. The thinner the fuel bed, the greater is the liability to burn through and consequently much care must

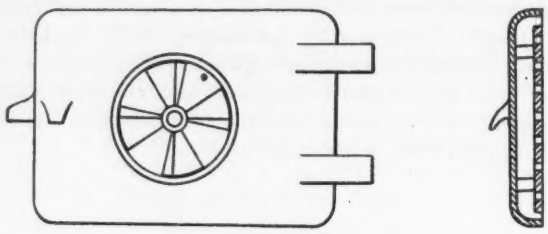


Fig. 1

be exercised. The fuel must be fired at frequent intervals and in small quantities at each firing. It might seem to many that such a system is exceedingly laborious because of the strict attention necessary. But it must be remembered that by carrying a thin fire the combustion is brought under more perfect conditions so that it is not necessary to fire so much fuel to produce a given result as would be the case if the fuel bed were thicker and the coal fired in greater quantities at longer intervals.

If the fuel used is one which contains a large percentage of volatile matter there will be considerable difficulty in regulating the admission of air through the grates to obtain the best results. At each firing of fresh fuel a large vloume of hydrocarbon gases will be set free and it will require dexterous manipulation of the damper at this time to burn these gases and prevent smoke.

For the fine portions of the fuel lie so close together that they impede the passage of the air. Usually, grates are made with from 40 to 60 per cent of air space. But when a bed of fuel six inches thick has been placed upon them, the amount of space which is open to the passage of the air supply is very much diminished.

Also, the greatest need for a large air supply arises at the moment when a new charge of fuel is fired since the main portion of the volatile matter is distilled from the fuel at that time. But since the air passage is much reduced by the compact fuel bed, since much of the oxygen is burned to carbon dioxide in passing through the fuel, the result is that there is not nearly enough oxygen present to combine properly with the gaseous hydrocarbons.

It has been found that the admission of air above the grates as well as below them aids in bringing about the desired results. There are many ways of doing this, and by far the most common is the opening of the fire door, through which the furnace is charged. This is a very easy and rapid way of regulating the air supply but it has no other features to recommend it. Beyond its quickness of application it is decidedly disadvantageous. When the fire door is opened, the air is drawn into the furnace in the shape of a column, rather than in distributed form. This column or current must then distribute itself as best it can, which frequently is very poorly, indeed. The admission of this air is supposed to supply the necessary oxygen for the proper combustion of the gases just formed from the coal. But instead of promoting the combustion, this sudden inrush of air

chills the gases and retards combustion for a time at least, if not altogether, and in that way defeats its own ends. And not only that, but the chilling effect is carried to the boiler plates also.

It is not advisable, then, to regulate the air supply by manipulating the fire door. If air is to be admitted through the fire door, let it be through the orifices provided for that purpose. Fig. 1 represents the fire door of an ordinary return tubular boiler. It consists of an outer casing or door proper, provided with a rotating circular shutter, whose vanes may be made to cover or to uncover the holes in the door casting. On the inside of the door, or on the furnace side, a perforated plate is placed, which is held in position by bolts passing through both the door and the plate. The purpose of this plate is two-fold. First of all, it receives the direct radiant heat of the furnace and thus protects the door proper from being quickly destroyed. The perforated plate may be renewed cheaply when it has burned or warped so as to be unfit for further service. Its second purpose is to distribute the air which enters through the apertures in the door. It will be noticed from the illustration that the perforated plate is held away from the door by lugs cast with the plate. The bolts which hold the plate to the door

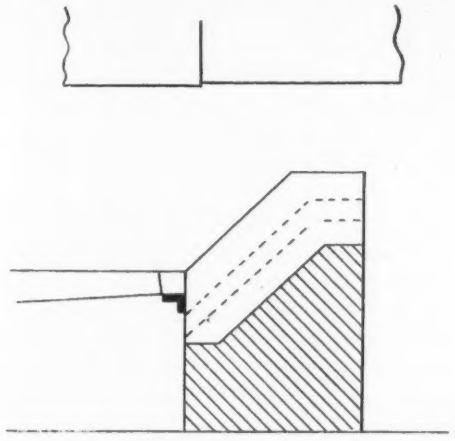


Fig. 2

pass through these lugs or bosses, which are cored to receive them. There is thus formed a space between the door and the plate. When the air enters from the outside, it first strikes the perforated plate. But the perforations which are opposite the holes in the door are not of sufficient area to allow all the air to pass directly through to the furnace. As a consequence, the current is deflected in all directions and the air thus fills the entire space between the plate and the door. Inasmuch as the plate is highly heated, the air also becomes quite hot before it passes through to the furnace. Once deflected by the perforated plate, the air then flows through the holes and around the edges of the protecting plate in a number of small streams, thus giving a good and fairly uniform distribution of the air to the various parts of the furnace.

Even by this method, however, it is often found impossible to admit an adequate supply of air over the fire, and so there have been numerous devices invented by which to admit air through the bridge wall or through the sides of the furnace so as to give approximately complete combustion. One means of doing this is by the use of perforated tiles, as shown in Fig. 2. These tiles are made of fire-brick and are of such a shape that when placed side by side they form the top of the bridge wall. Each block contains an air duct., and when in their proper position these ducts in the tiles lead from a point below the grates in the ashpit to the rear of the bridge wall. Fresh air is thus

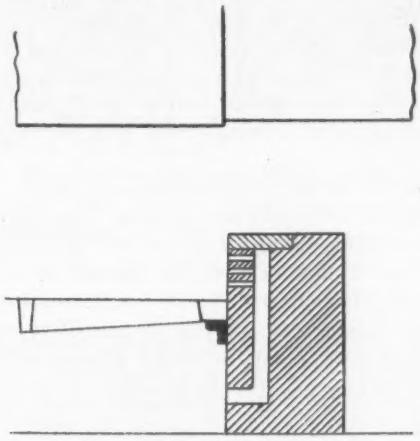


Fig. 3

admitted from the ashpit directly into the combustion chamber behind the bridge, the air being somewhat heated in its passage through the ducts, since the tiles are subjected to the heat of the furnace gases as well as to radiant heat from the furnace,.

Another method of accomplishing this purpose is shown in Fig. 3. In this instance, however, the air is admitted along the front of the bridge wall instead of the rear. Passages are left in the bridge wall which communicate with perforated fire-brick at the top of the bridge. As the air passes through these passages it is heated by contact with the hot bricks and when it enters the furnace it does so in a direction almost at right angles to the flow of the hot gases, thus giving a thorough commingling of the two. However, there is always the liability that the apertures in the tiles may become clogged by the soot and cinders carried toward the bridge wall by the currents of hot gases.

The use of steam jets to induce a strong air current has become quite common. The admission of steam into the com-

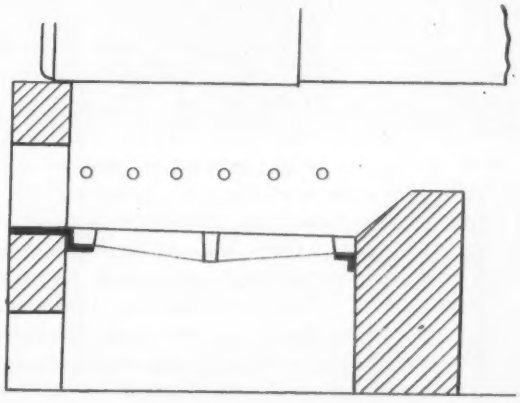


Fig. 4

bustion chamber does not of itself promote combustion. But by the use of the principle employed in the injector and in the ejector, a large amount of air can be drawn into the furnace by the steam jet. These jets may be placed either in the side walls

of the furnace, as in Fig. 4, or they may be placed in the bridge wall.

The methods of admitting air to the furnace which have been given represent only a few of the very large number of such arrangements. There are numerous boiler settings in which, by the construction of the walls, air passages of considerable length are formed, through which the supply of air is led before being allowed to mingle with the combustible matter. In general, however, these special settings are expensive, and the gain by their use is not commensurate with the increased first cost.

It is mainly in those instances where the draft is irregular, or the demands for power are variable, that the necessity arises for using some special device for the regulation of the air supply. With all such devices, the amount of air admitted should be under the control of the fireman by means of dampers. If such is not the case, the admission of air will be excessive at such times when the demand for steam is smallest.

Giant Generators

The Record-Breaking Machines to be Installed at Niagara.

Thirteen years ago, when the International Niagara Commission, established by the Niagara Falls Power Company, met in London, England, and decided that the generators for the installation of the company mentioned should each have an output capacity of 5000 electrical horse power, the engineering and scientific worlds stood astonished at the project and step. In the years that have elapsed these wonderful power producers have been installed and operated with great success, and the progress in electrical science has been such that to-day even greater machines are contemplated and contracted for.

In planning its proposed installation on the Canadian side at Niagara the Canadian Niagara Power Company will use generators of 10,000 electrical horse-power capacity. These machines will be wound directly for 12,000 volts, three phase, and will make 250 revolutions per minute. They will be of the internal revolving field vertical shaft type, the field ring to be built up of punched laminations bolted together, with joints lapped. In the long distance transmission, step-up transformers will be used to raise the voltage to 22,000, 40,000 or 60,000 volts. In every particular they will be wonderful machines, and are destined to command much attention from the engineering and electrical professions.

However, this does not wholly indicate the progress that is being made at Niagara in the creation of tremendous power producers, for it is announced that the Toronto and Niagara Power Company will have built generators of 12,000 horse-power output capacity. These will be the most wonderful generators ever made, and when in operation at Niagara must prove of great interest. These great machines will be operated by turbines placed deep down in a wheel-pit, the two to be connected by long shafts. Each unit of 10,000 or 12,000 horse-power capacity installed at Niagara means a further inroad into the water supply that pours down from Lake Erie.

The Toronto and Niagara Power Company has commenced work on its project, and during the next two years it will be pushed with great vigor in order that power may be supplied at the earliest possible moment.

Power Transmission in France

The Gas Company of Clermont-Ferrand, France, is now making an interesting hydro-electric installation which is designed to reinforce its existing electrical plant. The new works are situated on either side of the River Sioule, below a large dam which forms a lake about four miles long, having an average breadth of 130 yards and a surface of 250 acres. Independent pipe lines, fixed in masonry, will supply each of the six 1000 horse-power turbines, which are of the horizontal axle "Francis" type. Each turbine will be connected to a Westinghouse, three-phase alternator of 800 kilowatts at 1000 volts and 333 revolutions per minute. The two exciters, of 37.5 kilowatts each, are driven by small auxiliary turbines. The voltage will be stepped up to 20,000 by means of Westinghouse monophase transformers, grouped in threes. The overhead transmission line is to be double, and about 30 miles in length. Poles and crossbeams will be of wood, the latter being boiled in paraffin and then covered with a layer of tar. The setting up of the line, as well as the construction of the electrical and mechanical apparatus, has been undertaken by the Societe Anonyme Westinghouse, of Havre. The hydraulic part of the work has been hurried forward during the past year and is now well advanced, while the mechanical and electrical equipment is just finished. Power will be sold at Clermont-Ferrand, which is a great center for the rubber trade, for both lighting and power, and considerable development of the the existing works will be expected with the advent of a power so simple and so cheap as electricity.

Engineering for Cadets

Plans have been drawn for the new engineering building at the Naval Academy which was provided for by the appropriation of $400,000 by the last Congress. The plant will be used jointly as an adjunct to the course of steam engineering and for the purpose of conducting experiments, with a view of solving some of the engineering problems which are constantly being met with by the engineers of the navy.

The experimental plant at the Naval Academy will be unique. It will be at once a workshop and a laboratory. It will have a full-sized marine engine, and all of the immediate auxiliaries, and the steam-generating plant will be so arranged that boilers of various types can be tried under actual service conditions. There will be all sorts of aids to the work of investigation not commonly part of any ship's outfit. These will include special means for measuring the consumption of coal and of water and for checking accurately the development of steam for each pound of fuel and water. This marine engine will be so placed that reliable data can be secured as to the working economies of the mechanism at various speeds, and thereby it is hoped to solve one of the problems peculiar to naval craft which, unlike merchant ships running at no regular maximum speed, are really more expensive to drive at some of the intermediate velocities. This will have a direct bearing on the adaptation of triple engines and the use of three screws, which the Germans, after careful investigation, have placed in most of their large ships. There will be a physical and a chemical laboratory and an extensive electrical generating plant, and, as far as possible, all experiments will be made with full-sized mechanisms that the data may be both positive and more reliable than trials conducted on miniature scales.

The Ice Making Plant of the Norris Market, Philadelphia

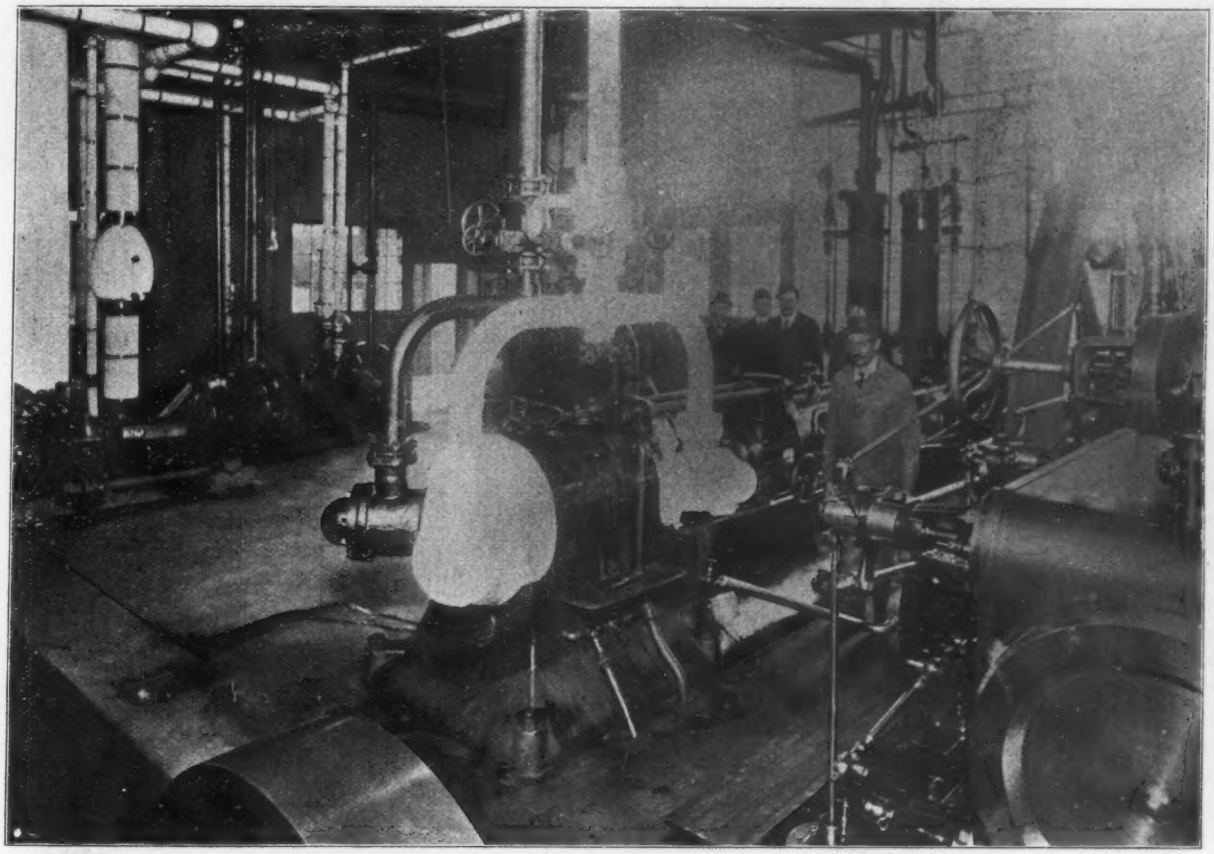
The feature usually embodied in the manufacture of ice are of more than ordinary interest to the average engineer, especially as almost every plant of magnitude is installing cold storage plants of smaller types as a part of the regular equipment. The following article is descriptive of the ice manufacturing plant of The Norris Market Company, 3rd and Norris Streets, Philadelphia, Pa.

Probably the most novel feature of this plant is the compact and efficient placing of the tanks and machinery, together with the scrupulous cleanliness at all times to be noticed throughout the plant.

this stands a 300 horse-power Berryman feed water heater. These will be noticed by a glance at the left of the first engraving.

A step further brings us to the 60 ton horizontal ammonia compressors manufactured by the Vilter Manufacturing Co., Milwaukee, Wis. The compressors are driven by a Vilter-Corliss engine 24 x40, 61 revolutions per minute, running condensing. The efficiency of this machine will be observed as we progress with the story.

The second cut shows the tank room containing 1300 cans of the 200 pound size. These cans are immersed in the brine from which the heat is extracted by the ammonia gas passing through coils from the, before mettioned compressors. The



Vilter Horizontal Ammonia Compressor, 60 Tons Capacity, at Norris Market, Philadelphia

Upon entering the plant at the boiler-room door the visitor will notice a battery of two 125 horse-power return-tubular boilers manufactured by the E. Keeler Company, Williamsport, Pa. The method of firing is by hand, but there is ample room for handling the slice bar and shovel as well as convenient methods of obtaining coal and disposing of the ashes.

The boilers are fed by two duplex pumps 9 x 6 x, 12, manufactured by the Foster Engineering Co., Newark, N. J., A uniform steam pressure is maintained through a damper regulator manufactured by Thos. Walker & Sons, Frankford, Philadelphia, Pa.

Directly opposite the feed pumps is placed an air compressor, of the "Pohle" Pattern, manufactured by the Ingersoll Sergeant Drill Company, New York City, and stationed at the end of

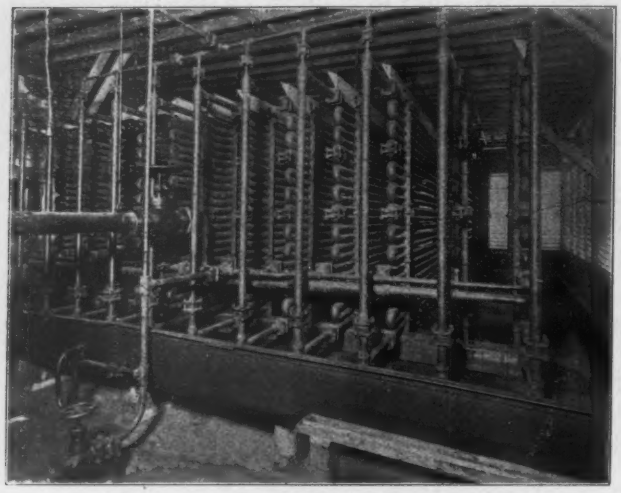
brine is kept in a continual state of agitation by two small engines, usually termed as agitators. After freezing the cans are raised from the brine and handled by hoists operated by air pressure.

A prominent feature is pipe covering, both the steam and brine pipes being insulated with Nonpareil Cork Covering. This type of covering is always at a advantage in ice plants owing to its non-distintegrating qualities under hot, cold, wet or dry conditions, coupled with very high effeciency.

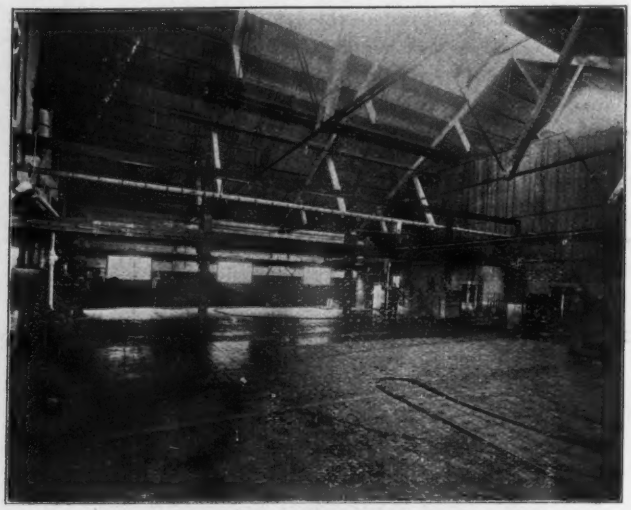
The third engraving shows a few samples of the output of the plant, and it will be noticed that the cakes of ice shown are as nearly perfect as it is possible for can ice to be.

To the rigyht of the freezing tanks is arranged a storage room capable of holding 3000 tons of surplus ice, an interior view of

which is shown in the fourth llustration. This room is cooled by pumping the cold brine through coils—the brine and the cooling effect will be noticed in the upper part of the cut. This completes the equipment of the first floor and shows the

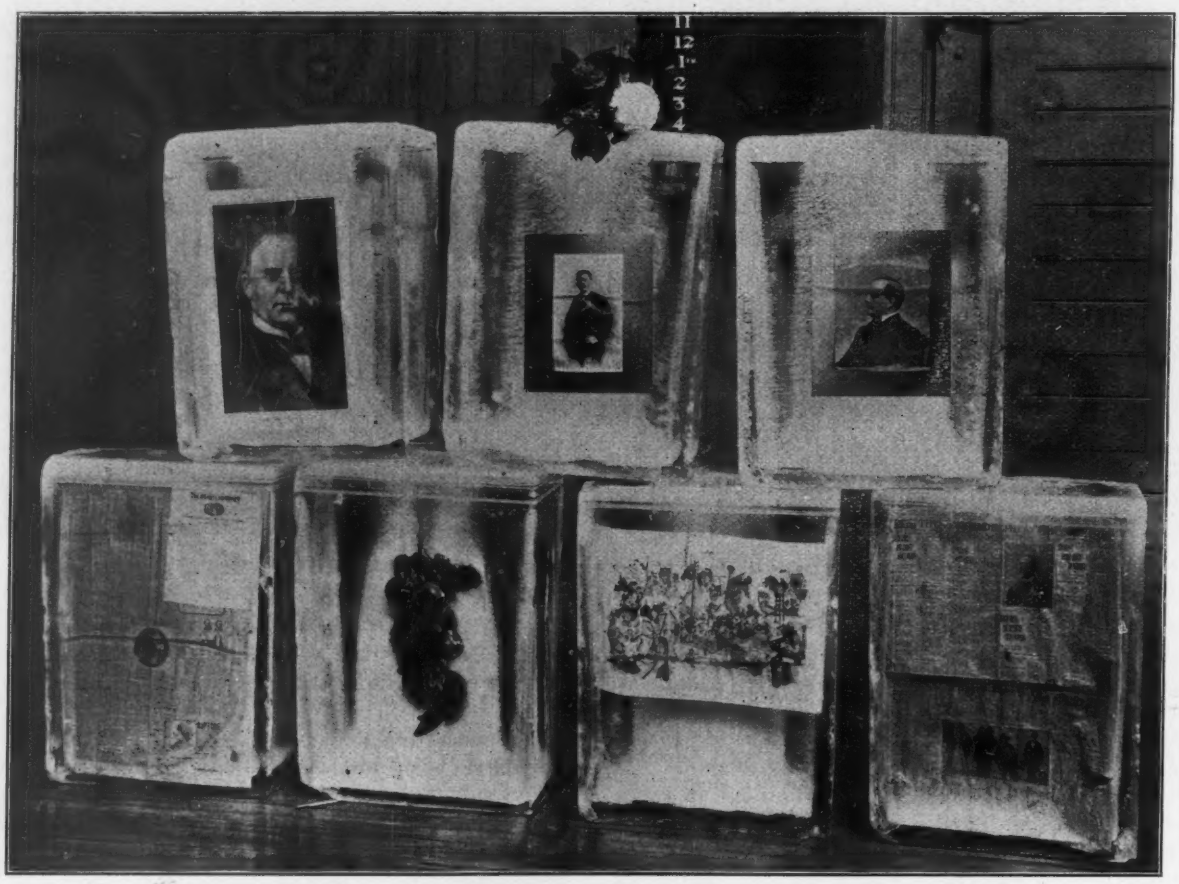


Showing Construction of Condensers



Tank Room

the floor above and are so placed as to be worthy of emulation by others anticipating engaging in the same business. At the top of the stairs leading to the second floor is to be found the ammonia condensers, five in number, 20 feet long, two inch



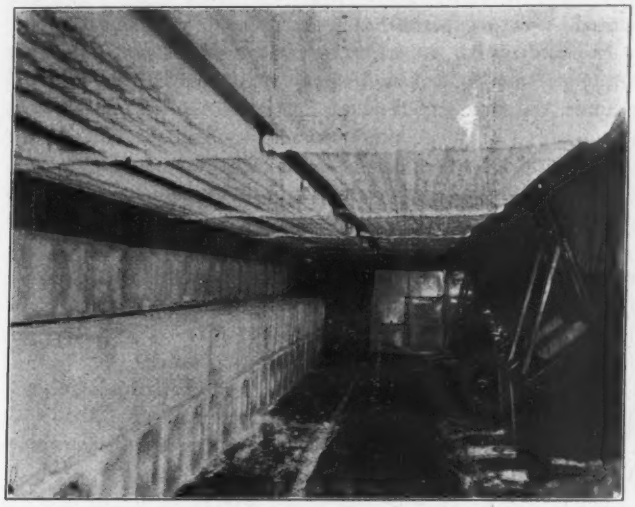
Some Sample Blocks of Ice Showing Unusual Clearness, Produced at Norris Market, Philadelphia

beginning and the ending of the ice making, but we have yet the intermediate methods to look over. These are found upon pipes and twelve pipes high. The cooling medium is water obtained from artesian wells of ample capacity, the pumping

being done by compressed air. To one side of this stands a 10 ton brine tank containing the brine used in the cold storage rooms, and to the other side are two great charcoal filters for filtering all the condensed water before it is permitted to go to the reboilers. The reboilers—two in number—are adjoining the filters,

The fourth engraving shows the method of construction of both the steam and ammonia condensers The cut shows the steam condensers composed of ten coils 24 feet long, two inch pipes twenty pipes high.

This handles the engine room exhaust; besides this, however, there is an extra condenser of 18 coils, twelve feet long, two



Cold Storage Room

inch pipe, 12 pipes high; this is to furnish all extra condensation required to keep up the necessary output of the factory.

Throughout the entire plant there cannot be found a leaking joint nor misplaced accoutrements. The credit for this is due to the able management of the chief engineer, Mr. William Helbling.

It will be interesting to know that in making can ice nothing but condensed water can be used when clear ice is required. This is necessary to remove the large amount of air contained in water under normal conditions, which, if not removed, makes the ice opaque when frozen in the cake. In plate ice plants this feature is removed because of the freezing all taking place from one side, as under natural conditions, consequently the freezing process expunges the air from it. This action cannot take place, however, in a can, as the freezing is from all sides equally and impurities not removed must be frozen in the centre of the cake.

In conclusion we will add that the cold storage rooms and plant is lighted by electricity supplied on the premises by a 15 kilo-watt Eddy type G. Generator, 110 volt current. The generator is entirely separate from the other machinery, being belted to an ideal engine.

Knocking in Engines

A very frequent cause of knocking in engines can often be traced to the valve; a case in point came under my observation. An engine pounded so badly that the engineer thought his brasses were loose, but on examination they were found to be all right. He then thought he could locate it in the crosshead in fact, it seemed to be everywhere. An expert was called in who, on indicating the engine, found that the eccentric had slipped and that the valve opened so late that the exhaust did not take place till the crank pin had passed the center about fifteen degrees, steam being admitted, of course, still later. Now, let us see what the result of this would be: The piston had to be dragged back against the steam; all lost motion being taken up in the opposite direction from which the engine was running, when suddenly the compressed steam being released and live steam admitted to the opposite side of the piston, the whole load was instantly transferred to the other side of the bearings with a shock that could hardly be equalled by a blow from a pile-driver hammer. Two facts may be deduced from the above: One is the difficulty of locating a knock in an engine when caused by the valve being out, and the other is, that it is not always safe to depend upon one's ear to locate a knock. Young engineers, and even some older ones, have been known to spoil the running of a good bearing by the mistake of thinking they could locate lost motion at that particular point and taking up a brass, when it was allright before. In such cases it is well to heed the advice of Davy Crockett, "to be sure you are right, then go ahead."

The Point of Cut-off

It must not be understood, (in reference to steam expansion) that the higher the grade or ratio of expansion, the greater is the economy, because, quite the reverse may often happen, as the results in practice are greatly modified in various ways by other considerations.

Consequently the most economical point of cut-off will vary in different types of engines, in accordance with the special conditions, and circumstances to which each may be subjected; such as high or low initial pressure, condensation of steam in the cylinder, different methods of jacketing and superheating, amount of back pressure and compression, incorrect adjustment of the valves, also a size of engine that is not adapted to the work, etc.; any or all of which necessitates change more or less of the point of cut-off, in accordance with any, particular condition, in order that the greatest efficiency of the engine may be realized.

In engines with an early cut-off, and where a high rate of expansion prevails, the mean or average pressure throughout the stroke must necessarily be low; and a low mean pressure, for a given power, necessitates the use of a larger engine.

Also a high rate of expansion leads to a, low terminal pressure, and to expel the steam from the cylinder after it has performed its work will require from one to three pounds pressure above the atmosphere; therefore, if the rate of expansion be such that the terminal pressure falls below this, the expansion is excessive, and the reverse of advantageous.

In non-condensing engines the lowest possible terminal pressure coincides with the pressure of the atmosphere, or about 14 7-10 pounds per square inch absolute; but 18 pounds may be considered as the lowest pressure to which steam can be expanded to advantage; and where the exhaust passages are small and tortuous, or where the exhaust steam contains considerable moisture, a still higher terminal pressure will be more economical.

In condensing engines, the temperature in the condenser is usually about 100 degrees Fah., and which corresponds to a pressure of every nearly one pound to the square inch; but the pres-

ence of air in the condenser generally prevents the pressure falling below two pounds per square inch.

From three to four pounds is the more usual and may be considered as the lowest advantageous final pressure to secure the best economy. The highest advantageous rates of expansion

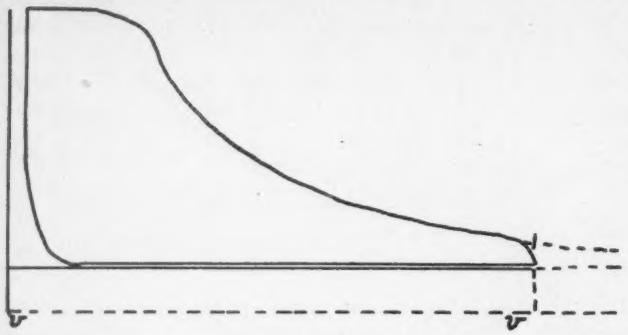


Fig. 1

with jacketed cylinders appear in practice to be between twelve and sixteen; but in unjacketed or exposed cylinders, the limit of advantageous expansion is much below the lowest of the rates mentioned.

The principle cause of the discrepancy between the theoretical and actual economy is in the amount of heat lost in changing the water (by condensation or otherwise) in the cylinder to the condition of steam, most of this heat passing out with the exhaust steam, either into the condenser or the atmosphere. It has been fairly well demonstrated by frequnet tests that the most favorable point of cut-off, in a simple non-condensing engine, is usually about one-fourth stroke, when using steam of from 80 to 90 pounds per square inch initial pressure.

Where the cut-off is earlier than this a greater per cent. of loss is induced through cylinder condensation; and where the cut-off takes place later in the stroke there is also an increase of loss, from the fact that the steam is exhausted and lost while yet at a considerable pressure.

Fig. 1 is a fair representation of an indicator diagram from an engine working under the favorable conditions mentioned.

The results of some recent experiments on a 17 by 30 inch stroke non-condensing double valve engine by Prof. J. E. Denton, to determine the relation of steam consumption to point cut-off is illustrated by the graphical diagram Fig. 2.

The line A. B. represents the stroke of the engine, which is equally divided into tenths and twentieths, to denote the various points of cut-off in fractions of the stroke, or periods of admission of steam to the cylinder.

From each of these fractional parts of the stroke perpendicular lines are erected, and also above these points are horizontal lines laid off 1-5 of an inch apart; each representing four pounds, or a scale of twenty pounds per inch; being actual pounds of water used per horse power per hour.

Through these lines three curves are plotted, being the result of experiments at various points of cut-off, and boiler pressure by which the change in the rate of water consumption, corresponding to changes in point of cut-off, (as well as changes in in boiler pressure) are readily observed.

The three curves shown in the diagram corresponds to 90, 60, and 30 pounds boiler pressure respectively per square inch, and the curves were constructed by locating points as a result of tests in each case at different rates of cut-off. It will be clearly seen that the curve corresponding to 90 pounds per square inch boiler pressure and the steam cut-off at 1-4, or 25-100 of the stroke gave the best results, and represents a water consumption of about 26 pounds per horse power per hour, that for 60 pounds pressure, cut-off at 35-100 of the stroke, a consumption of about 32-1-2 pounds, and that for thirty pounds ipressure, cut-off at 45-100 of the stroke, corresponds to a consumption of 43 pounds of water per indicated horse power per hour.

For a short distance on either side of these points of cut-off the amount of water consumption is only slightly increased and the economy is practically the same, but in case of very early or very late cut-off the amount of water consumed is considerably increased; the relation of economy to cut-off being well represented by these experiments in the diagram.

In some similar experiments with a small (7x14) Buckeye automatic non-condensing engine, with a boiler pressure of 75 pounds, the same experimenter has found the best rate of consumption to be 30 pounds of water at about 1-4 cut-off; and while the most favorable point of cut-off is the same in small as in large engines, the matter of economical use of steam is in favor of the larger engine and high pressure.

It should be understood that these results were deduced from refined tests, extending over a considerable period, the engines being in perfect condition as to leakage, etc., and the steam collected, condensed and carefully weighed after the work was performed, thus eliminating errors as far as possible.

The steam was also practically free from moisture, as, in the tests of Fig. 106 it contained less than one per cent.

From these and other similar tests we are enabled to formulate the folllowing approximate rule for best cut-off.

Divide 100 by 42 times the square root of the initial pressure and the quotient will represent the most favorable point of cut-off expressed in fractions of the stroke. The initial pressure must be recoked from a vacuum for condensing and from the atmosphere for non-condensing engines.

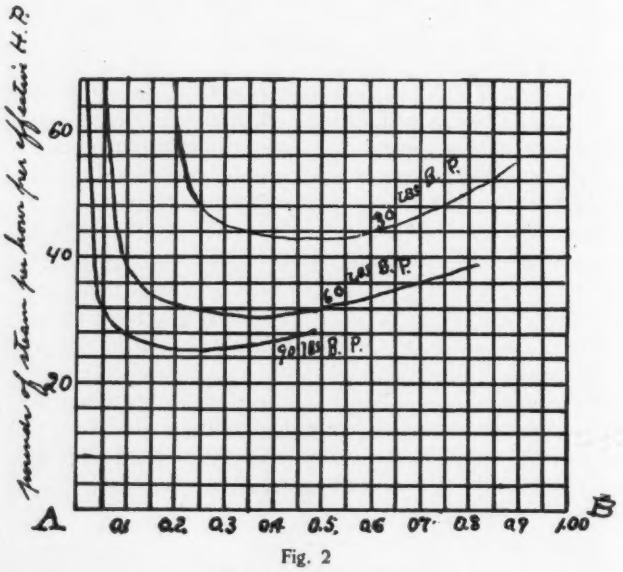


Fig. 2

In a test for ascertaining the economy of engines, it is very important that the quality of the steam used, or in other words the amount of moisture it contains, be determined.

This quantity may be approximately found by making what is known as a calorimeter test.

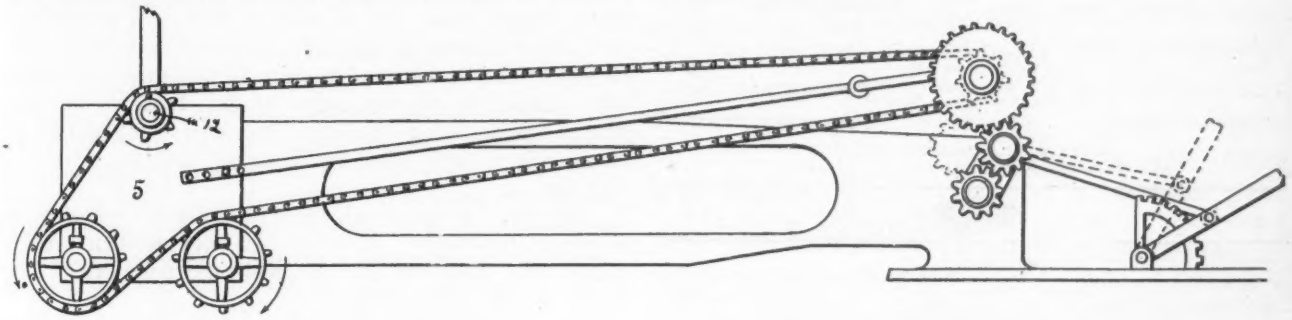
There are a number of instruments of varied construction and principle, on the market for this purpose, with full and complete instructions for their use.

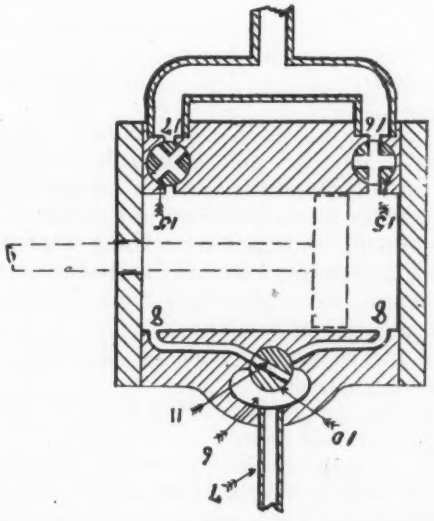
In the absence of such a test, no accurate conception of the amount of steam actually used by the engine to produce a horse power per hour can be obtained, for the steam may contain a large amount of ineffective moisture in the form of spray, which can only be detected either by an application of the calorimeter, or by collecting and weighing the exhaust.

The generally acknowledged economy that has been attained in the steam engine within the last thirty years (estimate between thirty and forty per cent.) may be considered due, principally to the employment of multiple eylinder engines in connection with the best modern method of jacketing; also an increase of steam pressure, and superheating the steam; either or all of which (when judiciously made use of) tends to better efficiency and more economical results.

A Novel Valve Mechanism

The accompanying illustrations show a very unique valve reversing mechanism for steam engines. The strongest point of the arrangement is the doing away with the usual eccentric





rod, and associated parts by the substitution of rotary devices and transmitting gearing adapted to drive the valves so as to admit the steam equally to opposite ends of the cylinder alternately; and to exhaust in like manner therefrom. Thus any possibility of an unbalanced stroke is overcome and the use of cylinder cocks entirely obviated.

A further object is to provide a simple reversing mechanism, in which the elements are held, locked firmly in their adjusted position, so that the lead can be reversed by a simple movement of the lever.

The same numerals of reference denote like and corresponding parts in each of the several figures of drawing—5 designates the cylinder, 6 the feed chamber, to which the steam is supplied by pipe, 8 is the inlet parts, 10 is a revolvable inlet valve, having a single transverse passage, 11, 12 valve spindle, 15 stuffing box, 14 is a lead on feed chamber 6, which can be removed for purpose of taking out the valves, 15, 15, are exhaust parts, 16, 17, are exhaust valves with intersecting passages see (figure 2.)

It will be seen that the valve 10 travels at half rate of the engine and valve 15, 15, at quarter rate of the engine.

It can also be made as an expansion cut-off by the size of inlet part 11.

The wear on the valves will be greatly reduced by their having such slow motion, and by the way in which they are placed the back pressure will also be greatly reduced. The reverse is also so simple that it will be understood without explanation.

Heating and Ventilating a Cotton Mill

The Hope Mills Mfg. Co., of Hope Mills, N. C., has equipped its mills throughiou with the "hot-blast" system of heating and ventilation. All steam-coils are concentrated in a heater in the basement through which the air is drawn by a fan and distributed to the several rooms through galvanized iron piping and brick flues. The fan is driven by a direct-connected horizontal engine which exhausts into a section of the heater. The remainder of the heater is of such capacity that, using exhaust steam from the mill engines, the building can be heated to a temperature of 70 degrees F. when the temperature is 10 degrees above zero out-of-doors. The finishing building and the weave shop each contain two stories, and in addition, provision has been made for furnishing enough heat to the first story of the storehouse to prevent the freezing of the automatic sprinkler apparatus for fire protection, while the second story is to be heated to 70 degrees F. The guarantees are based upon the use of fresh outside air, although when warming up in the morning the air may be drawn from the interior, thus saving a considerable amount of steam. Live steam at 90 lbs. pressure is to be used at night, but, as stated above, the pipe capacity of the heater is sufficient to permit the use of exhaust steam from the power-plant of the mill in the day-time. The equipment was installed by the B. F. Sturtevant Co.

The Practical Engineer

PUBLISHED ON THE FIRST OF EACH MONTH

L. L. RICE, Proprietor

46 North Twelfth Street Philadelphia, Pa.

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PUBLICATION COMMITTEE

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Evolution of the Engineering Profession

The engineering profession is making such rapid strides and developing so much importance in the commercial world that it is being made a feature of by our leading universities. But a decade ago it was classed third or fourth among the trades, now we find that any college of consequence in the country have steam engineering courses which are on a par with the other professions. The University of Michigan has about completed an engineering building at a cost of $150,000. Following this is an announcement of the errection of a building of equal magnitude by the United States Government, at Annapolis, In the future our naval cadets will be instructed in that point, heretofore neglected, which was proved in the last war to be paramount to all others about a ship; namely, the handling of the steam equipment.

We also have an announcement that the University of Pennsylvania, is about to break ground for the erection of a building containing 128,000 square feet of floor surface. The building is to be used exclusively for the study of steam and electrical engineering, as the follow will indicate.:

To the west and north of the shops will be the mechanical laboratory and a part of the electrical laboratories. At the western entrance will be a dynamo and motor room in which direct-current work will be carried on. Provision for high voltage and railway work will be made in the adjacent laboratory.

In the mechanical laboratory steam and gas engines will be installed, each installation being complete with its apparatus for doing the special kind of testing for which it is to be used. Certain engines will be used for valve settings, others for determining mechanical efficiency and others for determining the entire heat efficiency of the installation. A condensing apparatus and a small cooling tower for the steam engines and a moderate-sized suction producer in connection with the gas engines will make a complete working installation. A high-pressure water service with accumulators and belted and steam-driven air compressors will make it possible to carry on any experiments with hydraulic and compressed air transmission. A boiler of 100 horse-power to supply saturated or superheated steam for experimental purposes will be installed near a small erecting floor, on which any kind of machine may be mounted and quickly connected up. Special testing rooms will be provided for refrigerating work, for experiments on heat transmission through pipes and radiators, and for experimental work on fans. Apparatus will be installed for measuring power transmitted in various ways and for testing the material used by the mechanical engineer. A large water-supply tank will be located above the third floor, and cisterns beneath the first floor will receive the discharge from the various machines. A number of water wheels now in the possession of the department, steel flumes for handling the water and weirs and meters for measuring it, will afford facilities for laboratory work in this line.

Adjacent to the mechanical laboratory will be the electrical laboratory, in which all measurements to be made away from the machine will be carried on.

Oil on the Water

The results of experiments in burning oil as fuel made by the Bureau of Steam Engineering, U. S. N., appears in the recent report of the Chief of that Department. The conclusions reached are as follows:

1. Oil can be burned in a very uniform manner.
2. The evaporative efficiency of nearly every kind of oil, per pound of combustible, is probably the same. While the crude oil may be rich in hydrocarbons, it also contains sulphur; so that after refining, the oil has probably the same calorific value as the crude product.
3. A marine steam generator can be forced to even as high a degree with oil as with coal.
4. Up to the present time no ill effects have been shown upon the boiler.
5. The firemen are disposed to favor oil, and therefore no impediments will be met in this respect.
6. The air requisite for combustion should be heated, if possible, before entering the furnace. Such heating undoubtedly assists the gasification of the oil product.
7. The oil should be heated, so that it can be atomized more readily.
8. When using steam, higher pressures are undoubtedly more advantageous than lower pressures, for atomizing the oil.
9. Under heavy forced draft, particularly when using steam, it has not yet been found possible to prevent smoke

issuing from the stack, although all connected with the tests made special efforts to secure complete combustion.

10. The consumption of liquid fuel probably cannot be forced to as great an extent with steam as the atomizing agent as it can when compressed air is used for this purpose. This is probably due to the fact that the air used for atomizing purposes, after entering the furnace, supplies oxygen, while in the case of steam the rarefied vapor displaces air that is needed to complete the combustion.

11. The efficiency of oil fuel plants will be greatly dependent upon the general character of the installation of auxiliaries and fittings; and therefore the work should be entrusted only to those who have given careful study to the matter, and who have had extended experience in burning the crude oil. The form of the burner will play a very small part in increasing the use of crude petroleum; for where the burners are simple in design, and are constructed in accordance with scientific principles, they will differ but little in efficiency. Consumers should see to it, carefully, that they do not purchase appliances that are untried, and have been designed by persons who have had but limited experience in operating oil devices.

The Vacuum in the Condenser

The purpose of adding the condenser to a steam engine is to reduce the back-pressure against which the engine must operate by removing a greater or less portion of the atmospheric pressure, which of course increases the horsepower which the engine can develop; for, the effective pressure upon the piston is the difference between the forward pressure at any instant and the back-pressure at the same instant; and consequently the power obtained by removing a portion of the back-pressure is the same as that obtained by increasing the forward pressure a like amount. But there is this advantage in the use of the condenser. No more heat needs to be added to the steam to give the increased pressure. Instead, more of the heat is taken out of the steam, using the same initial pressure, and exhaust takes place at a lower temperature and pressure. In this way the full expansive power of the steam is more nearly utilized.

This removal of back-pressure is attained by the condensation of the exhaust steam, either by direct contact, as in the jet condenser and ejector condenser, or by the transference of heat to the cooling water through metal tubes, as in the surface condenser.

Suppose that the release in a condensing engine takes place just as the pressure of the steam in the cylinder becomes equal to that of the atmosphere. Then the exhaust steam at that moment has a temperature of 212° F. Upon entering the condenser, it is at once reduced to water by the abstraction of its latent heat. Now, roughly speaking, steam at atmospheric pressure occupies 1700 times the volume of an equal weight of water at 212° F. Consequently, for every 1700 cubic inches of steam condensed, there results one cubic inch of water.

It is this decrease in volume of the exhaust steam which causes the increase of effective pressure on the piston: for by the shrinkage in volume, a partial vacuum is formed ed on the exhaust side of the piston, since one cubic inch of matter now occupies the space previously filled by 1700 cubic inches, leaving 1699 cubic inches of unfilled space, representing the vacuum formed by the condensation.

The more nearly perfect this vacuum, the greater the amount of back-pressure removed, and the greater the increase of power. The vacuum obtained in the condenser is measured by a gauge called a vacuum gauge, which registers in in ches—meaning inches of mercury—from which reading the pressure in the condenser may be readily found, remembering that for each inch registered by the gauge, 0.49 of a pound of pressure is removed from the back pressure.

It is impossible to obtain a perfect vacuum in the condenser. There are many condensing engines in operation whose condensers show 26 inches of vacuum, corresponding to an absolute back pressure of about 2 pounds; and under the very best of conditions, a vacuum of 28 inches has been obtained. But this is high and is exceptional rather than general.

Why Injectors Don't Work

Probably no other boiler accessory is subjected to the same amount of abuse and neglect than the injector.

Our experience and observation has shown us that as a rule they are badly located, being placed in some dark and obscure corner of the boiler room, frequently fitted up with poor and old piping and valves, while on the other hand it should be located at a convenient point where it is accessible, with plenty of light, and have the very best of piping and valves; very frequently no attention is given to its care or wants and it is abused when it fails to work, caused by such neglect and want of proper care.

We have found that many engineers consider it necessary to punish it when it does not work, which is brought about by some of those causes, and abuse it with a hammer or wrench, backed by lots of angry muscle.

Let us warn all operators that nothing can be gained in the working of any injector by hammering it and frequently much harm is done as you are liable to jam or mar the shell and force the jets out of line by springing some of the diaphragms, and the only remedy is a new injector.

You have a watch and you are governed by it as a time-keeper; all at once it stops, do you take a hammer to it or go through it with plyers and screw driver? No; you are very particular to take it to a jeweler or watch repairer that you have confidence in to locate the trouble, and have it put in proper running condition. In many respects the Injector is just as delicate and sensitive as your watch, so give it as good a chance.

Seventeenth Annual Convention American Order of Steam Engineers

There is probably no city possessing so many attractions of interest to engineers as the city of Pittsburg, and the delegates and officers who attended the Seventeenth Annual Convention of the American Order of Steam Engineers in that city, on the 11th, 12th and 13th of May, showed their appreciation of the city's enterprise.

There was present in all, forty-two delegates, representing twelve States, and a more jovial, and companionable lot of men have not often attended one of the order's annual conventions. Twenty-eight of this number arrived together on the Pennsylvania Limited, which reached Pittsburg at 7 P. M. Sunday, the party being composed of delegates from Philadelphia, Baltimore, Atlantic City, and points through Eastern Pennsylvania. The trip out was a jolly one, especially after the Baltimore delegation boarded the train at Harrisburg.

The delegates began to arrive in Pittsburg on Sunday morning, the 10th inst, and at eleven A. M., Monday, the convention was called to order, with practically every man in his place.

Supreme Chief Clifford P. Williams presided at the opening session, and, after the opening formalities, a recess was declared and City Solicitor John A. Blair was introduced, who delivered a pleasing address of welcome.

The afternoon session was a busy one and it was six P. M. before the doors were thrown open.

The work of the afternoon consisted entirely of routine business, reports of committees, etc. The secretary's report showed that per capta tax had been paid on about six hundred more members than in the year previous. The report of Supreme Treasurer Richardson showed a larger cash balance on hand than in any previous year in the history of the order, much of which he attributed to the economical administration of retiring Supreme Chief Williams.

On Monday evening Iron City Council held an open meeting, at their hall at 1117 Penn. avenue, which was attended by many of the delegates as well as by a number of local engineers, including some of the most active members of the N. A. S. E. and the I. U. S. E. Several interesting and instructive addresses were made by representatives of each of the organizations, all of which urged more thorough organization and pointed out the necessity of harmonious co-operation for the general interest of all members of the profession of stationary steam engineering. The meeting was voted a success by all present.

The Tuesday morning session of the Supreme Council was called to order at 9.30, sharp, and few of the delegates were seen outside again until a recess was taken at 1.15 P. M. This proved to be the most important session of the meeting, as it was at this session that the new officers for the ensuing year were elected; the election resulting as follows: Supreme Chief Engineer, Noah A. Pierson, Maryland; Supreme First Assistant Engineer, W. S. Price, New Jersey; Supreme Corresponding Engineer, Jas. H. Stallings, 3032 Dillon St., Baltimore, Md.; Supreme Recording Engineer, Chas. W. Leng, Pennsylvania; Supreme Treasurer, Geo. W. Richardson, Pennsylvania; Supreme Senior Master Mechanic, A. Keppleman, Penna.; Supreme Junior Master Mechanic, Joseph T. Harris, Wisconsin; Supreme Chaplain, C. H. Pfeiffer, New Jersey; Supreme Inside Sentinel, H. R. Taliaferra, New Jersey; Supreme Outside Sentinel, Samuel Logan, Delaware; Supreme Trustee three years, Clifford P. Williams, Pennsylvania;

When the delegates emerged from the convention hall, the new officers were surrounded and congratulated from all sides. Mr. Pierson, the new Supreme Chief, proving especially popular.

There was never any doubt about Mr. Pierson's election—he was the largest man present at the convention; more than six feet tall and weighing close to 300 pounds He looks every inch a leader. He was a candidate for the office, and was frank enough to say so, and with his own abundant good nature added to that of his half dozen fellow delegates from Maryland,

Noah R. Pierson
Supreme Chief Engineer, American Order of Engineers

all of whom were an exceptionally jolly lot, It was not surprising that he won the confidence and support of all present.

The election of officers as well as every other feature of the convention was an exibition of harmony and good fellowship, and the American Order has every reason to look forward to a successful and happy year.

Mr. Pierson, the new Supreme Chief, has specially requested us to say that it is his desire to increase the membership and influence of the order during the year and to promote the largest possible measure of social intercourse among the members, and to this end he will welcome and carefully consider suggestions and advice from all members of the order, and also from the many friends of the order whose faces have been familiar at the conventions and who have otherwise shown a friendly interest in the order. These outside friends, said Mr. Pierson, have been weighed in the balance and have not been found wanting. They have helped our order in many ways, and if any of them have any suggestions to make for its advancement I will be pleased to give them the fullest consideration.

Tuesday afternoon was devoted to sight seeing. Committeemen A. D. Hamilton and Martin Kean took most of the delegates for a visit to Schenley Park and to the Carnegie Institute, while a number of others divided into groups and went to see other points of special interest, such as the great Homestead Steel Works, Jones & Laughlin's, the Westinghouse Shops, etc.

For Tuesday evening the committee had arranged a banquet, which was given in the dining rooms of the Hotel Victoria. There were about 150 guests present, who partook of the excellent menu prepared. There were several excellent speeches delivered, chief among which was one by Mr. A. C. Rice, Editor of "THE ENGINEER." Mr. Rice spoke of the advantages of organization, and the educational benefits to be derived therefrom. There were other speeches by Grand Chief Trout, Past Supreme Chief Franklin R. Moore, Mr. Stewart, Chief of Iron City Council, and others. Mr. Daniel Ashworth made a most delightful and efficient toastmaster, and was frequently applauded.

Wednesday morning the convention was down to business early and kept at it until 12.30 noon. The session was devoted to installation of new officers, routine business and the discussion of means and methods for advancing the interests of the order and increasing its membership.

THE PRACTICAL ENGINEER was discussed at some length, and Mr. L L. Rice was called in to discuss matters of mutual interest.

Mr. Rice stated that the circulation of THE PRACTICAL ENGINEER had increased 3500 copies per issue since the Reading convention a year ago, and that the receipts from advertising had nearly doubled.

It was thought that the morning session, on Wednesday, would wind up the business of the convention, but a short session in the afternoon was found necessary. This session, however, only lasted from 2.30 until 4 P. M., when the convention finally adjourned to meet again, at the call of the Supreme Chief, one year hence.

THE SUPPLY MEN

Much of the pleasure and good times at the Pittsburg convention of the A. O. S. E. was creditable to the engineer's supply men, of which there were some twenty-five or thirty present, and all of them the best of good fellows, always ready to entertain a stray delegate, to tell a good story or exhibit a new trick to a crowd. Speaking of tricks, there were more good ones and more interesting amusement novelties sprung by this bunch of salesmen than one is likely to see in a decade. Wherever a bunch of heads was seen together there was sure to be something new and interesting, and most of the delegates came home with a supply of novelties, ranging all the way from a loaded stogie to a "Hazel nut." These "Hazelnuts" were easily the most popular novelty at the convention. They were given out as souvenirs by the Penna., Electrical and Railway Supply Co., of Pittsburg, who are the manufacturers of the Larkin Metallic Packing. We cannot tell what it was about them that made them so much sought after, but we noticed that every time one was cracked there was a grand rush for a look. Mr. H. M. Laughlin, the fat and jolly representative of the concern, said that he had given away 900 of them and the demand was greater than ever. He also informed us—between laughs—that he would be pleased to send a small sample box of Larkins Self Lubricating Metallic Packing to any engineer writing for it.

The committee of arrangements had provided a nice large room on the second floor of the hotel for exhibiting supplies and steam specialties, and there were several attractive exhibits.

The Foster Engineering Co., of Newark, N. J., had an interesting display of specialties in charge of D. Lewis Dalrymple, who took much pleasure in explaining their piston actuated pump governor, pressure regulators, automatic valves, etc.

Jenkins Brothers had a handsome exhibit, composed chiefly of Jenkins Valves in a variety of styles and sizes, and of Jenkins Standard "96" Packing, all of which was in charge of Mr. J. T. Buckley, who represents the firm in Pittsburg, and Mr. William G. Lecompte, the Baltimore representative of the firm, Lecompte was already well known and popular, and Mr. Buckley made a host of new friends among the boys.

One of the most attractive exhibits was the display of Nonpareil Cork, by John R. Livezey, which was in charge of Harry E. Souder, the manager of Mr. Livezey's Pittsburg office, located in the Builders Exchange. Mr. Livezey and Mr. Williams, both from the Philadelphia, office, were also there, and there were but few delegates or visiting engineers but that made the acquaintance of some of this hustling trio, and learned something of the insulating qualities of cork. The exhibit contained specimens of cork for many purposes, including a variety of thicknesses and styles for steam and brine pipe covering, for which this novel product is fast superseding most other materials. There was also specimens of sheet cork for cold storage insulation, which probably has no equal for lightness and efficiency, cork flooring for eliminating sound, cork tiling for decorating, etc.

The Keystone Lubricating Co., displayed a number of large sample cans of Keystone Grease of different densities, and gave out souvenirs and advertising literature, expalining the great value of "Keystone" as a lubricant for all kinds of engines and high grade machinery. The company was represented by their manager, Mr. A. C. Buzby, Mr. Chas. A. Hopper, their Philadelphia salesman, and Mr. Geo. Norman, their traveling salesman for Pennsylvania, all of whom proved exceedingly popular with the delegates.

Decidedly the most interesting exhibits there was the new Kuhlewind Momentum, Governor exhibited by The Anchor Engineering and Machine Co., 105-7 Pike St., Pittsburg, and demonstrated by Mr. C. Kuhlewind, the inventor and president of the company. Mr. Kuhlewind proved exceedingly popular with the delegates and visitors, but not more so than did his governor, which drew the attention and received the approval of practically every engineer present. A brief description and illustrations of this governor will be found in an advertisement on another page of this issue, but in a later issue we will publish a detailed description of it.

The Garlock Packing Co., had an attractive display of their well-known brands of packing, which was in charge of Mr. E. P. Watrous, manager of the Company's Pittsburg house. The Garlock Company was also represented by Mr. L. E. Adams, manager of the Philadelphia house, Mr. Haggart and Mr. Hadcock.

The Pennsylvania Electrical & Railway Supply Co., of Pittsburg, had a nice display of Larkin Metalic Packing, samples of which were given out in small boxes as souvenirs. This exhibit was looked after by Mr. Hammond, Mr. Laughlin and Mr. Green.

Another interesting exhibit was that of the Quaker City Rubber Co., in charge of Mr. Thos. Sincock, of their Pittsburg

office. This display consisted of "P. P. P." Packing, "Ebonite' Sheet Packing, Daniel's Graded Valve Grinders and other specialties manufactured by the company. Mr. Sincock gave each delegate a neat little cigar case containing a good cigar, and he also gave out patent steel packing rules as souvenirs, which were greatly appreciated.

Tate, Jones & Co., whose offices are in the Empire building, Pittsburg, Pa., exhibited the "Kirkwood" Patent Fuel Oil Burner and the "Kirkwood" Natural Gas Blast Burners. These two specialties were interesting to many, and the catalogues and other advertising literature which they gave out were handsome specimens of the printer's art.

There were several other small exhibits, but a majority of the supply men present did not exhibit samples, but contented themselves with mingling among the delegates and interesting them in various ways. Among the latter was the Dearborn Drug and Chemical Works, which was represented by A. W. Crouch, T. W. Wilson and H. A. Pastre. These three jovial fellows did every thing in their power to entertain the visitors, and it is neeeless to say that they made a host of friends. Nothing was too much trouble for them, and they had a new story or an amusing trick to spring on every one.

The Keystone Chemical Mfg. Co., of Camden, N. J., were ably represented by Mr. Wm. Bray, who was much sought after for the many interesting and valuable little sourvenirs which he gave out, chief among which were handsome leather match safes and a little booklet, entitled, "Worth Knowing," which latter treats upon boiler incrustation and the remedy, and also contains much data of general interest to engineers.

H. B. Underwood & Co., the well known Philadelphia machinists, were ably represented by Mr. McGarvey, a jolly, fat fellow, who laughed himself into popularity.

"Power" was represented by Mr. L. G. Vogel, and "The ENGINEER" by Editor A. C. Rice and Mr. Shaw.

The firm of Thos. C. Warley & Co., of 221 So. Front St., Philadelphia, was represented by Mr. Warley himself.

The interests of the Pittsburg Steam Packing Co., of 210 Second avenue, Pittsburg, were looked after by Mr. C. H. Fiske, the Secretary of the company. Mr. Fiske was formerly manager for the Garlock Packing Co., and is well known to many of our readers; he is an agreeable and popular fellow, and made many friends among the delegates.

And last, but not least, comes Jas. L. Robertson & Sons, of New York, who were represented by Mr. Thos. G. Keogh. Mr. Keogh has attended several of the more recent conventions of the order, and is so well and favorably known that comment is superfluous, other than to say that his orders for Eureka Packing and Improved Robertson-Thompson Indicators probably aggregated more than those of any other man's present.

CONVENTION NOTES

A D. Hamilton, chairman of the convention committee, looked well nigh exhausted when it was all over.

Lew Vandergrift was an exceedingly popular member of the convention committee, many of the "boys" were visitors at some of the several plants that he has charge of, and all declared they had never seen plants in more perfect condition. Personally, we think him a first class fellow if he would let up on the loaded stogies that always go off when least expected.

Grand Chief Trout had his own troubles with the boys at the banquet; but then you know, Grand Chief, that "boys will be boys."

Past Supreme Chief Franklin R. Moore was there looking just as young, and apparently enjoying the convention as much as ever.

Lehigh Council No. 15, of Allentown, Pa., is now the third largest Council in the American Order—a fact of which Past Grand Chief A. P. Dreisbach, who was a delegate to the convention, is justly proud.

Guess where the next convention will be held.

Past Supreme Corresponding Engineer J. C. McDowell and Delegate W. S. Wetzler left the convention to go for a few days fishing down on the Juniata river. Some of the rest of us envy them.

We don't know how they do it down there in New England, but its a fact that Past Supreme Chief John T. Dodge, of Boston, appears younger and better looking than he did ten years ago.

A prominent and very welcome visitor at the Convention was Mr. Herbert E. Stone, Past National President of the N. A. S. E.

Delegate William J. Eccles, of Philadelphia, wore a happy smile and evidently had a good time; fact is, we are pretty sure that he had.

Grease in Boilers

The action of grease in a boiler is peculiar, but no more so than might be expected. It does not dissolve in the water, nor does it entirely decompose. Neither does it remain on top of the water; but it seems to form itself into what may be described as "slugs," which at first seem to be slightly lighter than the water; of just such a density in fact, that the circulation of the water carries them about at will. After a short season of boiling, these "slugs" or suspended drops, seem to acquire a certain degree of stickiness, so that when they come in contact with the shell and flues of the boiler they begin to adhere thereto. Then under the action of heat they begin the process of "varnishing" the interior of the boiler. The thinnest possible coating of this varnish is sufficient to bring about over-heating of the plates. We emphasize the point that it is not necessary to have a coating of grease of any appreciable thickness to cause overheating and bagging of plates, and leakage at seams. The time when damage is most likely to occur is after the fires are banked; for then the formation of steam being checked, the circulation of water stops, and the grease has a chance to settle on the bottom of the boiler and prevent the contact of water with the fire sheets. Under these circumstances, a very low degree of heat in the furnace is sufficient to overheat the plates to such an extent that bulging is very likely to occur. Of course there is greater likelihood of trouble with some kinds of oil than with others, animal oils being most troublesome, and mineral oils least so. When oil is used to remove scale from steam boilers too much care cannot be exercised to make sure that it is free from grease or animal oil. Nothing but pure mineral oil should be used.—*Exchange.*

Self-Cooling Transformers

Through the successful transmission of high voltage currents over long distances has been advanced by the introduction of the polyphase induction motor, and improvements in electrical machinery generally, the greatest credit belongs to that which has made the use of the others possible—the high-voltage transformer.

On all high potential transformer current circuits the oil-insulated, self-cooling type is undoubtedly the best at the present time. And of these, those made by the Westinghouse Electric & Mfg. Co. are of high rank, having been in active operation for a number of years with uniform and marked success. Improved from time to time in disign and manufacture, they now represent the latest step in modern practice.

The general design devised by this company and used for the first time in its smaller transformers has been adhered to, only such modifications having been made as experience and varied requirements have rendered desirable.

The many advantages of oil insulation have made it almost essential for high voltage transformers, while the heat conducting power of oil also serves to keep down the temperature.

In the Westinghouse transformers both high tension and low tension winding are divided into many flat coils. The high tension conductor, in all transformers except the very small sizes, is a flat copper ribbon wound concentrically with only one turn per layer. The layers are separated from each other by a specially prepared insulating material in addition to the cotton covering of the conductor, while the coils are insulated individually and are separated by heavy insulating washers. This form of construction is such as to practically eliminate any danger of break-downs between layers or from turn to turn—one of the most common troubles in transformer operation.

The low tension is wound in the same way with conductors of rectangular cross section. In the larger transformers many wires are paralleled and are arranged in such a manner as to eliminate eddy currents in the conductors.

The advantages of this improved method of winding employed in the oil-insulated self-cooling transformer may be summed up as follows:—

(1) The total E. M. F. of the transformer is divided among many coils, reducing proportionately the strain within an individual coil.

(2) The E. M. F. between layers is reduced to that of a single turn (ranging from 10 to 25 volts).

(3) The coils may be spread apart at the ends so that a very large surface is exposed to the oil, thus providing ample radiating facilities:

(4) The regulation of the transformer is greatly improved by the interlacing of coils which is permitted by this method of construction.

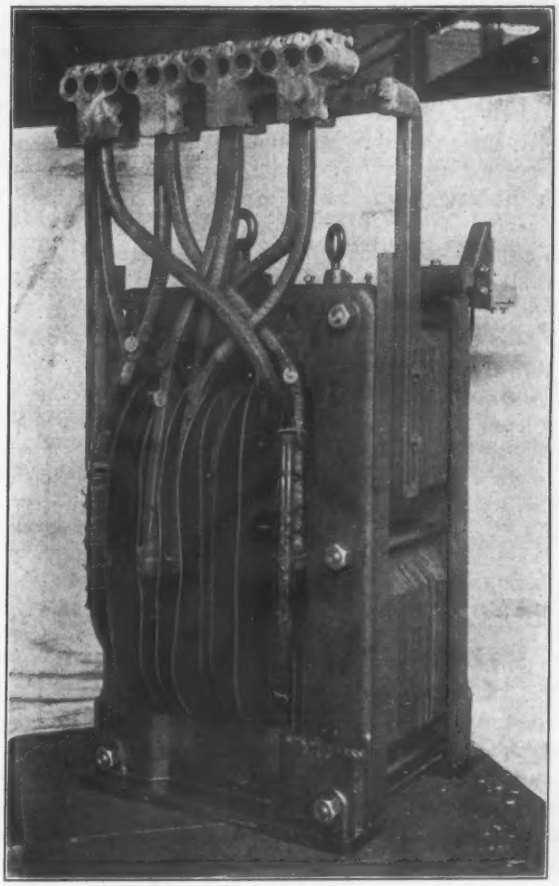
(5) In case of damage to a coil another one may be substituted with little trouble and without returning the transformer to the works.

The importance of a free circulation of oil between the coils of a transformer is often underestimated. Its absence permits the interior to attain a temperature much higher than that of the exterior, resulting at times in the destruction of the coil insulating material by unequal expansion or contraction. The iron, as well as the copper, requires a low and uniform temperature to prevent deterioration.

Oil passages or ventilating ducts between the coils and in the iron provide an even heat distribution and a consequent uniformity of temperature throughout the transformer. The arrangement of these ducts between the coils is such that when the transformer is operated, a vigorous circulation of oil is set up directly through the interior of this winding, and the ducts placed at freqpent intervals between the laminations bring rapidly moving oil within less than one inch of every particle of iron in the transformer.

The amount of heat developed in a transformer depends upon its capacity and efficiency. In a 500 K. W. transformer of 98.5% efficiency there is a loss at ful load of 7½ K. W. or 10 H. P. Since this loss appears as heat, it must be disposed of, to prevent a dangerously high temperature.

This heat may be dissipated by simple radiation from the



Core and Coils

surface of the contaiing case; by the circulation of water through pipes immersed in oil, or by the constant removal of heated oil and its return after having been cooled. The advantages of the first simple method are obvious.

To dispel the heat generated in a transformer of the self-cooling type a case with a large surface area exposed to the air is required. The greater the radiating surface, the lower the temperature. The Westinghouse transformers are mounted in heavy sheet-iron cases protected by an outer framework of angle-iron. The surface area of the case is increased by corrugations, and is capable of radiating an immense amount of heat.

The high tension terminals are mounted on a marble slab at one end of the transformer, the leads being brought out through bushings. The low tension terminals are mounted at the oppo-

site end of the transformer on a steel bar heavily insulated with mica, making an entirely safe construction.

In a transformer the losses are of two kinds: 1st, iron loss due to magnetic reversals in the iron; 2d, copper loss resulting from the passage of current through the conductors. The iron loss, which is practically constant, at all loads, must be very low if a high efficiency at small loads is to be obtained. These losses have been reduced to a minimum by careful proportioning of the iron and copper.

In large transformers for long distance transmission, close regulation is of even greater importance than in the ordinary small transformer for lighting circuits, as the drop in the line is often of considerable magnitude, and with raising and lowering transformers the transformer drop occurs twice between the generator and the load. This drop is greatly increased when the power factor of the load falls below unity, as it does where current is supplied to induction motors. It is therefore particularly necessary that close regulation be obtained in transformers designed for transmission work, especially if used for supplying motors. This point has received careful attention in the design of the transformers described, and the highest practicable standard of regulation has been attained.

Oil-insulated self-cooling trans formers may be wound for practically any voltage desired. The following high tension voltages, however, have been adopted as standard: 2200, 6600, 11000, 16500, 22000, 33000 and 44000. Taps are brought out from the high tension winding for three lower voltages. This provision makes it possible to use duplicate transformers at both ends of the transmission line, the taps on the lowering transformers accommodating them to the reduced line voltage. The following table shows the exact voltages for which Westing house standard transformers are wound:

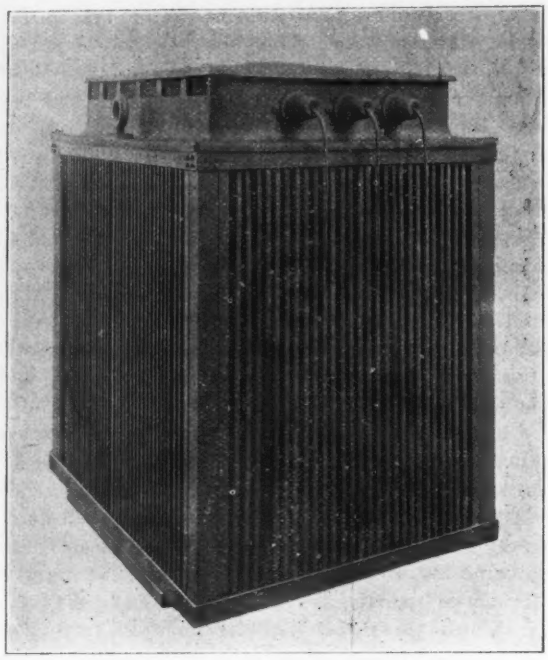
Standard Voltages for Oil-Insulated Self-Cooling Transformers.

2200	6600	11000	16500	22000	33000	44000
2100	6300	10500	15750	21000	31500	42000
2000	6000	10000	15000	20000	30000	40000
1900	5700	9500	14250	19000	28500	38000

Transformers of a capacity not exceeding 150 K. W. may be wound for voltages as low as 50, and the larger transformers for voltages as low as 100. Either or both windings may be divided into two equal parts so arranged as to permit either series or multiple operation, the change being effected by a simple rearangement of connectors on the terminal block. Taps may be brought out from the low tension winding for ample variation in both voltage and ratio, and are provided for a total of five voltages: full voltage, 5% and 10% less than full voltage, half voltage, and 5% less than half voltage.

The advantage of three-phase transmission over other systems are well known, and the three-phase system is almost universally adopted in long distance installations. Oil- insulated self-cooling transformers may be arranged for transforming two-phase currents into three-phase currents and vice versa. Transformers are connected in pairs, and although the two transformers in each pair require slightly different voltages, they are of similar make, with a sufficient number of terminals for procuring the proper E. M. F. for either position in the pair In addition, provision may be made for one other three-phase voltage, 5% or 10% lower than normal.

Transformers are often used to supply lighting systems, where, as the load and consequent line drop increase, it becomes necessary to raise the voltage of the system. Oil-insulated self-cooling transformers may be provided with taps which can be connected to a standard regulator dial mounted directly on the transformer case or switchboard. By means of these the secondary voltage may be varied by small steps from 5% below to 5% above normal voltage; this range can also be extended to 10% above and below the normal voltage.



Completed Transformer in Case

Where rotary converters are employed, it is often required that the E. M. F. of the direct current vary over a wide range. This variation is obtained by a corresponding variation in the E. M. F. of alternating current supplied, and this in turn may be accomplished in a manner similar to that described in the preceding paragraph.

In connection with either a two-phase or three-phase rotary, the oil-insulated self-cooling transformers which supply the rotary may be arranged for three-wire direct current distribution.

Water for Use in Hydraulic Elevators.

In hydraulic elevator service little heed is usually given to the quality of water with which the system is operated. Much loss of power by friction and many dollars spent annually in repairs can be avoided by a little thought and action on this subject. In order to prove the truth of this statement, one has only to obtain two samples of water, one of soft water and the other of what is commonly known as hard water. For example, take rain water as the first sample and water from the well as the second. Now rub your hands briskly together while holding them immersed in one, and then in the other of these samples. You will instantly realize that the quality of water used in elevator service has much to do with the efficiency of the hydraulic machinery. Water from the service pipes of the city water-works always contains more or less sand and other gritty substances, in suspension, and this grit acts much

the same on the packing and metal parts of the apparatus as does a sand blast. Some engineers, having realized the evil effects of water in the state that it is generally used, have attempted to remedy the matter by replacing the water which is lost by leakage or evaporation by the addition of the water which is discharged from the steam traps of the plant; and as this has been distilled, it is almost chemically pure—thus the man who uses distilled water in an elevator system instead of the water containing grit, is simply getting out of one difficulty into another.

It is a well known fact in chemistry that pure water is a solvent for every known substance, and will especially attack iron to a large degree. Whenever it is practicable, the water for elevator use should be passed through a filter to remove grit before being allowed to pass into the surge tank. In many cases, however, it would be difficult for the engineer to convince the owner of the advisibility of buying and installing a filter for this purpose.

A simple and somewhat inexpensive remedy is within reach of all—the plentiful use of castile soap will obviate many of the evil effects of hardness of the water, will douuble the life of the packing, will reduce the loss by friction, and will, to a large extent, prevent the chattering of the pistons, making the elevators run much smoother. In laboratory practice, the degree of hardness or softness of water is determined by the amount of pure soap that is necessary to mix with the water to form a lather, or to precipitate a certain quantity of carbonate of lime and other substances. This same action, on a larger scale, takes place when soap is introduced into an elevator tank, and while the only portion of the soap forms an emulsion with the water, of great lubricating properties, the gritty matter is precipitated and can be gotten rid of through means of a blow-off in the bottom of the tank. In a plant of six elevators, with usually a storage capacity of some 8,000 gallons, it is a good practice to use about twenty pounds of this soap each week. The soap should be at first dissolved in about ten times its weight of boiling water, and when cold it will form a stiff soft soap. The practice of putting in the refuse oil collected from the drip pans is of little value; it will not mix with the water, but floats on the surface. It rarely gets low enough to enter the suction pipes of the pumps, and has little or no tendency to precipitate the solid matter that is held in suspension in the water.

Elements in Estimates on Horse-Power

As a moment's reflection will readily reveal, the elements entering into the estimate of an engine's horse-power are the effective temperature of the steam, as indicated by the mean pressure throughout the stroke; the content of the cylinder, as indicated by the length of the stroke and the area of the piston; and the number of revolutions per minute. The product found by multiplying these factors will give the number of foot-pounds made available; which expression, divided by 33,000, gives the indicated horse-power.

The denominator, 33,000, expresses the number of foot-pounds per minute in a horse-power. Thus, a horse-power is such a force as can lift a weight of one pound through 550 feet in each second, or such as can lift a weight of 550 pounds through one foot in each second. This force constantly exerted through one minute, or sixty seconds, can lift 33,000 pounds through one foot, or one pound through 33,000 feet. Since, however, the action involves motion, it is cumulative in both time and space; requiring an increased area of operating surface, or an increased length of time, or both, to accomplish work in excess of the figures given. Thus, an engine exerting precisely one effective horse-power can raise 10 pounds through only 3,300 feet per minute, or 55 feet per second, and requires 10 minutes or 600 seconds to raise 330,000 pounds through the vertical distance of one foot. To so enlarge the capacity of an engine that it can do ten times the indicated amount of work in a given space of time, or, so that it can do the indicated amount of work in one-tenth that given time, involves that the cubic content of its operating chamber, or cylinder, be proportionally increased, in order that ten times the amount of steam may be utilized in a given time, or for the accomplishement of a given work at each stroke of the piston. For it is evident that a mean effective pressure of 45 pounds per square inch means 90 pounds available pressure with a piston area to two square inches; 180 pounds available pressure with a piston area of four square inches, and 22.5 pounds available pressure with a piston area of 1-2 square inch.

On the basis of these evident principles, a simple rule may be derived for calculating the indicated horse-power. This, however, is always in excess of the actual efficient horse-power, While there are numerous formulæ for determining this point one of the most familiar is as follows:

(a) Find the area of the piston by multiplying the square of a radius in inches by 3.14159 (ratio between circumference and diameter).

(b) Find the pressure in pounds on the piston by multiplying the area by the mean pressure per square inch.

(c) Find the length in feet traveled by the piston per minute, by multiplying the length of the stroke in feet, or fractions of a foot, by twice the number of ascertained revolutions of the crank shaft per minute. This equals the number of strokes per minute for a double-acting cylinder.

(d) Find the foot-pounds available during the given space of time (one minute) by multiplying the pressure, in pounds, by the length traveled by the piston, in feet.

(e) Find the I. H. P. (indicated horse-power) by dividing this last product by 33,000.

The formula is: PLAN 33,000 equals I. H. P.;

P being equivalent to the M. E. P. (mean effective pressure) in pounds per square inch.

L being equivalent to the length of the stroke in terms of feet.

A being equivalent to the area of the piston in square inches.

N being equivalent to the number of strokes of the piston, or twice the number of revolutions of the crank-shaft, per minute.

The element of speed, as expressed in terms of strokes, or revolutions, per minute, is important, and fundamental, in estimates on power, since, as must be evident from what has already been said, the superior power-capacity of one engine over another consists principally in being able to do, for example, ten times the work in a given time, or to do the same work ten times as fast. Therefore, an engine that can propel a given mass and weight of machinery at 300 revolutions of its crank-shaft and fly-wheel per minute, is evidently three times more powerful than another engine which can move the same mass and weight of machinery at only 100 revolutions per minute. Consequently, in forming the expression for the horse-power ratio of any given engine, the other essential factors of the numerator are to be increased as the number of times per minute the engine performs its complete cycle.

LETTERS FROM ENGINEERS

IN ORDER to make this department of THE PRACTICAL ENGINEER as interesting as possible, a moderate rate will be paid by us for all contributions published under this heading. However, we do not assume responsibility for the ideas or opinions expressed. None need hesitate to contribute because of inability to draw or write well. We will redraw or revise whenever necessary—it is the idea we want. New ways of doing old things, criticisms of accepted theories, and general engine-room experiences are especially solicited.

One Result of Meddling

EDITOR PRACTICAL ENGINEER:—

I remember an accident which occured some years ago in a small town quite a distance from railway communication. The accident was the direct result of the "Boss" knowing more than the engineer about the engineer's business—a very frequent state of affairs in the "Boss's" minds.

The engineer in charge of the plant mentioned was a bright young man who knew his business. Shortly after his taking the place he became aware of a clicking noise inside the engine cylinder and decided to take off the caps and investigate it on the following Sunday.

On Saturday the Superintendent came to him and told him that they would have to run at night for awhile, and, as they were unable to secure an extra engineer, directed the engineer to take the night shift and they would let the fireman run the day shift, as they could watch him better during the day and see that nothing went wrong.

On Sunday, with the assistance of the fireman, the engineer removed the cylinder head and found the piston rings in such bad shape that it was impossible to make them steam tight between the piston rings and cylinder walls. Realizing that he could not get new rings sooner than a week at least he replaced the old ones and made them moderately tight, and otherwise placed the engine in shape to do double duty for the ensuing week. He then ordered a new set of piston rings.

The work being finished up about noon the engineer left the fireman in charge while he went home to get some sleep. Now it happened that the "boss" came along just after he left and in talking to the fireman he learned what the engineer had done with the piston rings, he at once stopped the order for the new ones and then had the fireman remove the cylinder head and follower plate that he might look at the rings himself. He then ordered the fireman to set the rings out still more, saying at the same time that the engineer did not know his business. This done everything was put in shape again.

Now when the engineer came on duty in the evening and started up he noticed a groaning noise issuing from the cylinder. At first he attributed this to improper lubrication, but as it still continued he mentioned it to the fireman, who had not yet gone home; the fireman then related the experience he had with the "boss" and what had been done. Mentally telling the "boss" what he thought of his interference he decided to let her run; this she did for about an hour when there came a crash accompanied with the hiss of escaping steam and upon investigating it was found that along with it had come the cylinder head and also a piece of the cylinder, completely wrecking the engine for the time being. Now who was to blame for the accident?

TANGLEFOOT.

The New Haven Engineer's License Law

EDITOR PRACTICAL ENGINEER:—

When we engineers of Massachusetts have our attention drawn to the License Laws of other cities or States, we must admit that our Massachusetts Licence Law is far in the lead, even if there are some objectionable clauses.

It is quite probable that dissatisfaction will arise in the enforcement of the New Haven Law, and there are certainly several points in it that will bear comment.

Section 1 intimates what the law is intended for, viz:—that all operating engineers must hold a license, or must not operate in a plant for a period exceeding one week without one. This protects the manufacturers from a possible shutdown in case of the absence of the regular engineer for any reason; and also gives him time to obtain another licensd engineer, if necessary

Section 2 has some peculiar features, which are:—that the responsibility of appointing the three examiners is vested in the Mayor only, and the Board of Examiners hold their office by virtue of his will and sufferance, which may be swayed politically or otherwise. It would also seem that a mistake has been made in this section of the New Haven law. What inducements, for instance, are there for an engineer of ten years' or more experience to be confined to the office of Examiner without pay, to ask questions of applicants and to pass judgment upon the fitness of each? There can be no glory in it, and there is (apparently) no pay in it, nothing but the name:—Mr. So-and-so of the Board of Examiners. And what is there to induce Mr. Fish, the Fishmonger; Mr. Hay, the grain and produce merchant; Mr. Sweetland, who keeps the little candy store; or Mr. Carr, the conductor; or any other man, who knows nothing about steam engineering, to accept, when they are appointed on the Board of Examiners? And suppose three men are found, who are eager to serve their fellow-citizens without pay (a common (?) occurrence); one of them having ten years' experience as an engineer, the other two it matters not whether they can tell a steam gauge from a fly wheel; what would be the result? The engineer may have worked twenty years at the business, and still not be capable of examining a fifteen year old boy.

It may, of course, be claimed that discretion would be used in the appointment of these examiners; but we all know that men have been appointed to hold offices in other lines who were totally unfit for their positions; and why should the appointing of a Board of Examiners be other than a repetition of history?

Just what the two other members of the Board are expected to do is not clear. They certainly will not be expected to take part in examining the candidates; but if they do, we may expect to hear of some funny questions being asked, each flavoring of the business of the interlocutor.

Section 3 makes it the law to issue only what would be termed a Special License by the Massachusetts law, *i. e.*,—allowing the holder to operate in one certain plant and no other.

The feature of allowing the applicant to operate any one plant thirty days after he has filed his application for a license, and before his application has been acted upon, gives the engineer every chance to familiarize himself with his particular plant before his examination; and we boys of Massachusetts never fell into such a soft snap as that.

If the New Haven engineers are of a roving disposition, Section 4 ought to keep the Board of Examiners busy in keeping track of them as they make changes from time to time. If they are like some engineers, they would not have received their license from one application before filing another application for a license in some other plant.

Sections 5, 6, and 7 place the engineer under the thumb of the Mayor and the Board of Examiners, and their action in regard to the engineer and his license, is certainly full of possibilities.

If Section 10 means that the operating engineer shall not leave his engine and boiler to work about the shop as piper, general machinist, etc., it is almost enough to offset any criticism that the new law might be subjected to. Such a feature might well be placed in the Massachusetts License Law to the advantage of both the engineer and the public, and given a prominent place, too. It is not uncommon to go into an engine room and wait for half an hour or more for the engineer to put in his appearance. He isn't working about the shops for fun, we may be sure, but because his employers expect and require it of him; and, in the majority of cases, if he will not do this extra work, some other engineer will be found who will. Engineers dislike to leave their charges, but with no law prohibiting it, they are obliged to. A ten dollar fine, as in the New Haven law, would most likely make the engineer rather careful as to how he leaves his engine; and his employer, under such circumstances, can hardly ask him to do so.

The enactment of a license law is a step in the right direction, even if it does fall short of what it might be.

I. M. SPRY.

BROCKTON, MASS.

QUESTIONS and ANSWERS

THE editor will be glad to receive from the readers of THE PRACTICAL ENGINEER, such questions relating to engineering subjects, as may, from time to time, occur to them. All questions and answers should be addressed to the editor and accompanied by the name and address of the writer, which will not be published, however, unless especially desired. It is the intention that questions shall be answered by the readers, and even though the editor may, from time to time, publish answers and questions, he especially desires the readers in such cases to contribute any further information, in connection with the points raised, that they may consider of interest. All questions and answers received by the editor will be published, as far as practicable, but he reserves the right of editing or rejecting any communication.

EDITOR PRACTICAL ENGINEER:

Will you kindly answer the following query:—I am running a Webster, Camp and Lane engine 16 by 30 and have trouble with the link on the right-hand side jumping very badly, and it is even worse when working under full pressure. Can you give a reason?

W. C. SHARP.

[It is more than likely that your links and connections are badly worn. This is usually the action taken when such is the case and we know of no other reason for such a fault.—EDITOR.]

EDITOR PRACTICAL ENGINEER:

Will you kindly answer the following questions:—

What is angularity?

What is angularity lead?

What is angularity lap?

These questions were asked me by a mechanical engineer and I could not answer them and will appreciate your doing so.

C. C. MANTZ.

[Angularity in this particular instance has to do with the position, or angle, assumed by the eccentric rod in its rotation. Of course the lap and lead are affected by the angle of the eccentric rod, but both lap and lead are a fixed condition excepting in link motion engines, or in cases of variable cut-off single valve engines; so far as we know there is no such thing as angularity of either lap or lead, the word only relating to the eccentirc rod position and has no further relation to the engine.—EDITOR.]

EDITOR PRACTICAL ENGINEER:

Your answer to T. B. H. regarding a right-hand engine and a left-hand engine in last month's issue does not seem right to me. You say that one shall stand at the head end of the cylinder and look toward the crank, and that the engine is right hand or left-hand accordingly as the crank is to the right or to the left of the center line of the cylinder. From what I have learned, and from what engine builders state, this is wrong. To determine whether an engine is right-hand or left-hand, proceed as follows: Stand at the back end of the engine (that is, the head end of the cylinder) and look toward the pillow block. If the band wheel or flywheel is found on the right-hand, it is called a right-hand engine, and if on the left hand, a left-hand engine.

Allentown, Pa. J. T. L.

[In the answer referred to, as given last month, the printer is responsible for a rather hazy state of affairs, owing to his leaving out a full line of the answers. However, the first line is correct, and the method of determining a left-hand engine is correct, too. The answer says "stand at the head end of the cylinder." This is precisely what J. T. L. would do. Then, if the crank is to the left of the center line of the cylinder, it is a left-hand engine. J. T. L. says that if the bandwheel or flywheel is on the left, it is a left-hand engine. We fail to discover any real difference in the two methods. The first uses the crank as a basis for judgment and the latter the flywheel. If J. T. L. will kindly inform us of any right-hand or left-hand engine in which the crank and the flywheel (if there is one) do do not lie on the same side of the center line of the cylinder, he will bring to light a remarkable mechanical curiosity. Since the crank must always be used, while a flywheel is not always used, we think it far better to determine the kind of engine by the position of the crank rather than by the position of the flywheel.—EDITOR.]

EDITOR PRACTICAL ENGINEER:

Will you tell me the easiest manner of setting the Corliss engine valves?

J. MORRISON.

[In all Corliss engines you will find four valves, like the boy's description of a horse's legs, one at each corner. The two at the top on a horizontal engine are steam valves, those at the bottom are exhaust. On one side of the cylinder, you will find a disc, called a wrist plate, which is connected on one side by suitable rods to the eccentric motion, and on the other by rods to the four valves. Those at the bottom are permanently attached to the exhaust valve stems, while those at the top are attached, by means of locks, capable of releasing to the steam

valves. All of this will be found on the back side of the engine. Now go to the other or front side and remove the bonnets from the ends of the valve chambers, being careful not to drop the hollow flange pieces that turn in the bonnet and fit into the grooves in the end of the valves. You will probably find marks on the end of the valve that will show you the position of the steam cavity, also marks on the edge of the valve chamber, showing the position of the ports to the cylinder. If these marks are not there, make them at once. On the stud on which the wrist plates turn, there is, or should be, a mark showing its center position, and two other marks showing its extreme travel. Bring the center marks to position and clamp wrist plate, then adjust the valves by lengthening or shortening the rods till the valves will cover the steam ports a little, say 1-16 or 1-8 of an inch. Now will be a good time to experiment a bit. Find out how much your valve moves at one turn of its rod and you will then be able to tell how much you are moving your valve when you attempt to adjust it after the bonnet is on.

Now set the exhaust valves the same, only if it is a non-condensing engine you had better leave both of the ports a little open, say about as much as the steam valves have of lap. Now loosen up the wrist plate and notice the movement of the valves as Tom moves it backward and forward. You will see that the steam and exhaust valves are open at opposite ends at the same time. You will see that steam can be going into the cylinder at one end and the exhaust going out at the other. This is right, so put on all the bonnets except the one over the steam valve on the crank end. Bring the engine crank on to a center and place the eccentric at about right angles to it, either ahead or behind, according to the way the engine is to turn. There is usually a rocker arm between the eccentric and wrist plate. This is for the double purpose of relieving it of part of the weight and giving it more motion. These two rods should now be connected and the eccentric moved until the valve is brought line to line. Now put on the last bonnet and now to work. Have some one roll the engine forward in the direction it runs, till the crank is on the "dead center". Open your cylinder cocks. Then open the throttle slightly, so as to admit a small amount of steam to the steam-chest. Roll your eccentric forward in the direction the engine runs, until steam escapes from the cylinder cocks at the end where the valve should begin to open. Now screw your eccentric fast to the shaft. Roll your crank to the next center, and ascertain if steam escapes at the same point, at the opposite end of the cylinder. If so, ring your bell and go ahead. You are all right, and can run until opportunity occurs to open your steam-chest and examine your valve.—EDITOR.]

EDITOR PRACTICAL ENGINEER:

Will you please define in your question and answer columns how to balance a vertical engine for high speed? The engine is 6" by 6" with a fly wheel 24", or are they made in balance by the manufacturer? Some engineers claim that a vertical engine cannot be balanced.

MIKE DENLAM.

[An engine is always properly counterbalanced by the maker, and it is more necessary to counterbalance a vertical engine than one of the horizontal type. The counter-balancing weights are set at the point opposite the piston crank and are used to balance the weight of the crank, in the case of a horizontal engine, and the crank, cross-head, etc., in the vertical engine. In- properly counter balanced engines the valves should be set for an equal steam distribution.—EDITOR.]

Care of Steam Boilers

The management of steam boilers in all establishments is a subject of great importance, and one which does not, in many cases, receive the care and attention necessary in order to obtain the most economical results. When a steam user has decided to purchase a boiler, he should take steps to determine exactly what size and style will best suit his requirements.

If his engineer has the necessary ability he should be requested to make an evaporative test of the plant, and also to indicate the engine in order to determine the exact amount of water required to be evaporated, and the number of horse-power exerted by the engine.

Having this information it is an easy matter to arrive at the dimensions of the boiler required; but it must be remembered that it is always in the interest of economy to have a boiler larger than is necessary foı the actual requirements, as the grate surface cxn be proportioned to suit the case, fires can be run without any forcing, and good combustion and consequent economy of fuel secured, to say nothing of the increased length of the life of the boilers used under these conditions. If the engineer has not the ability necessary to determine these points, then some engineer of ability and good standing should be entrusted with the getting up of specifications both for the building of boiler and brick-work The boiler should be inspected frequently during construction, and, when completed, it should be thoroughly inspected and tested to one and one-half times the pressure it is desired to work, by hydrostatic pressure.

After the boiler has been set in position and the brick-work completed, it should be allowed to stand, if possible, for a week, in order to give the brick-work a chance to dry and set. After this, the boiler may be filled to the proper level and a small fire kept burning under it for a few days befor being put to work, great care being used so as not to heat up the boiler and brick-work too quickly.

In starting up a new boiler, it is a good plan to put in a few pounds of sal. soda with the water, and then, after brick-work is well dried and set, to let down fire and steam, run off the water and give the boiler a good washing out. This treatment will be found to prevent the foaming which so often happens when starting up a new boiler, and is caused by the grease left in it by boiler-makers.

From the time a boiler is started to work certain influences are at work, which, if left to themselves, will materially shorten its term of usefulness and safety; and it is the duty of the engineer to use every effort to check and counteract them.

The importance of the duties of the engineer and fireman are not as fully understood by many of our steam users as they should be, and too many owners are inclined to think that everything is all rightas long as the machinery keeps on the move. A good, intelligent, painstaking and thinking engineer or fireman, compared with the careless and indifferent man, will save his wages several times over. It is a well-known fact to many firms who have given the matter attention that a good fireman is almost invaluable, and that the difference in the fuel bill between a really good fireman and an indifferete man is astonishing at the end of a year.

The fireman should at all times, before starting his fire, see that the water in boiler is at proper level. He should not be satisfied by merely looking at the water-glass, but should open the cock at bottom of glass, and also try the gauge cocks. Many accidents have occurred by neglecting this duty.

When sure that the water is alright, he should see that blow-off cock is in order and closed, that the ashpit is clear of ashes, that the tubes are clean, and that the safety valve is raised off its seat, or that some valve or cock is open to the atmosphere until steam issues from it. The grate bars should now be covered (with coal) from the bridge wall toward the furnace door for about 3 feet, and should then put in some light wood on the grate in front of the coal, and with a little oiyl waste set fire to it.

When the fire has taken well hold of the wood, a little coal may be put on it. During this time, the ashpit should be closed and the furnace door left open a little in order that the flames may be communicated to the coal at the back of furnace.

As soon as a good fire is burning in the front of furnace, it may be pushed back a little and the ashpit damper opened. The fire should not be forced, but should be allowed to work up gradually, as the unequal strains some boilers are subjected to through forcing the fire when boiler is cold have caused leakage, and made expensive repairs necessary. In boilers of the Galloway, Lancashire and Cornish type, it is necessary to use great care in firing up from cold water, owing to the temperature of the water in the lower part of shell remaining low for a considerable length of time. The fires should be maintained level and of a uniform thickness, but the thickness must be determined by the demand for steam, condition of the chimney draft, and quality and nature of the fuel.

The firing is best done when the combustion in furnace is good, and consequently but little dense smoke is given off. Dark spots in the fire, abundance of smoke, unsteady steam pressure, unsteady water line, dirty tubes, coal in ash heap, are all evidences of careless firing, and should not be tolerated. Experience is the only thing that will prove the best methods of handling the different kinds of fuel under the different conditions to be met with in practice.

In the boiler room there should be a place for everything, and everything should be kept in its place.

All the fittings, mountings, boiler front, etc., should be kept clean and free from leaks.

The coal should be put on fire at regular intervals and lightly. If the furnace is large, it may be advisable to coke the fire, i. e,, to fire the green coal in front of furnace and allow the smoke to pass over a bed of incandescent, full at the back, and be consumed; then push it back and add more coal in front.

Sometimes side firing works very well; i. e., to always have one side of the fire incandescent when firing green coal on the opposite side. But no hard-and-fast rule can be set for every condition, and much must be left to the judgment of the fireman in each individual case. When firing or cleaning fires, where the chimney draft is very strong, it is advisable to check the stack damper to prevent too great a quantity of cold air entering the furnace and causing undue contraction of the plates. In boilers having large furnace, it is well when cleaning fires to clean one side at a time.

The fires should be banked at night, as it is more economical than to allow fires to burn out and re-light them in the morning, and it also saves the life of boilers to a certain extent, as, when fires are banked, the boiler is not subjected to so many strains by expansion and contraction.

The feed water should be kept constantly on, and the water-line maintained at the proper level all the time. Every day the steam pressure should be raised to the blowing-off point, so that the fireman may know that the safety valve is in working order. If at any time, from any cause, the gauge should show the pressure increasing rapidly up to or past the limit, the feed should at once be put on, draft checked, and in some cases it may be necessary to open the furnace doors. Should the water in boiler at any time get dangerously low, then close dampers, and open smoke-box doors immediately, and cover fires with damp ashes, or, if there are none at hand, small green coal may be used. Do not put on the feed, but allow the boiler to cool down some. After this the feed may be put on, and the tubes at back end examined for fear they may have been caused to leak from overheating.

If the water gauge glass and try cocks are attached to a column, there should be a blow-off pipe from bottom of column of at least 1-2 diameter, and this pipe should be carried to main blow-off pipe or sewer, and should be blown off at least once every two hours.

In cases of foaming or priming, if not caused by faulty construction of boiler, it can usually be prevented by putting on more feed and opening blow-off, thus changing the water in the boiler. But if the foaming is very violent, it may be necessary (in order to undermine the water-level in boiler) to close, or partially close, the engine throttle, open the furnace-door and increase the feed, and blow off the boiler a little at intervals. A surface blow-off cock is a good thing when a boiler foams, as by its use the scum and dirt can be cleared off surface of water.

A boiler should be cleaned out at regular intervals, but the length of time between such cleanings must be determined according to the nature of the feed water. A boiler using feed water from the Lake may be run for from six to eight weeks before cleaning, while, on the other hand, using feed water from a small stream it may be necessary in the spring of the year (when the water is very dirty) to clean the boiler every week.

When about to clean and wash out the boiler, the brick-work should be allowed to cool down as much as possible before the water is run off; then the hand hole covers should be taken out, and all mud and deposit removed by scraping out, then the hose should be used with a good water pressure and boiler washed out thoroughly. After this has been done, the water should be all drained out of bottom of boiler, and a light put into it through hand hole to make sure that no scale or mud remains on the bottom.

The man hole should be taken out once every three months, when the fireman should go inside, and, with proper cleaning tools, scrape off all deposit and dislodge all accumulations of scale, which will fall to the bottom of shell and can be removed through the hand-holes. After this has been done thoroughly, the boiler may be washed out well through the manhole. All joints should then be made, care being taken to make them perfectly tight, as, if allowed to leak and run down the boiler, it will cause corrosion of plates, and in time necessitate repairs. All soot and ashes should be removed from under boiler, previous to commencing to wash out, and tube ends and bottom of boiler, seams, etc., should be carefully examined for leaks, and if any are found, they should be caulked and made tight

without delay, as, if left for any length of time, they will cause expensive repairs and delays. If the boiler is subject to inspection, the bottom of sheel should be swept off, all dust and ashes removed from flues, and every facility given the inspector to enable him to do his work thoroughly.

A man in charge of a steam boiler should have a due sense of his responsibilities. He should be cool and collected in case of emergency, sober and industrious at all times, and should never put off till to-morrow the things that ought to be done to-day. This article on Care of Steam Boilers is not written for experienced engineers, but rather for the young fireman who is seeking information, and who has a desire to advance in his chosen calling. If it is read by even a few of the latter and proves in any way beneficial to them, then one of the objects in publishing this article will have been accomplished.

What Others Think of Us

So much has been written under American auspices as to the Englishman's ignorance of the value of a scrap heap, that were it all true there would be nothing left for us to do but go out of business forthwith. In spite of all the ruin prophesied, English goods seem to be gaining upon the foreigner in many directions, and when they do come off second it is usually because of a price that cannot be afforded or because of some question of delivery. Evidence is continually cropping up that points strongly to the real cheapness of the best and most durable articles.

Much is being constantly written concerning the rapid scrapping of obsolete tools to make room for newer tools of greater speed. A great deal of this is nonsense. The regular run of ordinary machine tools is not being so rapidly improved that it pays to scrap them every two or three years. Yet it is absolutely necessary to scrap many American tools in this period of time, purely because they are worn out and unfit to do good work. Just as the cottar's pig was killed to save its life—commercially, of course—so the scrap heap is made a virtue, because it really is a necessity.

In looking over a large number of machine shops it is obvious that there are necessities of far greater importance than the scraping of the old machinery. New tools have been put down under a leaking roof. They are crowded into a dark corner where not one-half of their utility and convenience can be secured. They are even placed on a dirty floor which will help quickly to spoil them. The excessive cost of manufacture is by no means always to be set down to the fault of tools. It is just as often the fault of arrangements. People who pride themselves on the excellence of their products, are content to carry on their business in a veritable rabbit warren of old dilapidated buildings, with small grimy windows, uneven patched floors, and unventilated rooms communicating in series by means of up and down bits of dark stairway. No supervision is possible. Materials are carried to and fro at great expense, and purchasers are gravely assured, though the price asked may be high, it does not represent an extravagant profit. Of this there is very little doubt. But the high prices ought to represent an extravagant profit, and only fail to do so, because of the badly- arranged workshops. New tools in such a shop are, if not a useless expense, at least not the most important want. Yet the proprietors of these shops never seem able to grasp the significance of the positio.n.

Manufacturing engineers who are considering re-organization should remember these points, and not too hastily throw away good quality for the sake of a cheapness which will rob them of their character. The craze for cheapness and rapid delivery has had a certain free run which is beginning to show results. Purchasers are beginning to find out something of durability, wear, breakage and repairs, and it is apparently not resulting badly for the despised Englishman.

It may pay the Americans to manufacture cheap stuff of no durability; they talk freely of the Englishman's ignorance of the use of a scrap heap, yet half the bridges in America would be promptly scrapped in Great Britain. It is all a question of circumstances. The Americans may have been right in the construction of cheap locomotives, right for America, but wrong for other countries. That they have been wrong in their ideas of machine tools is proved by the rapid increase in their weight since they were brought into competition with English tools.

Further, the more settled parts of the States are differentiating their practice from the newer States in every line, and modern practice is approximating to European standards every year.

The Powell "White Star" Valve

Heretofore the Powell "Star regrinding" valves were the standard product of this well known concern, but the accom panying engraving shows a new type of valve manufactured by them. This valve, it will be noticed, contains several features which will recommend it to steam uses in general. It is known as the "White Star" regrinding, reversible and renewable dish valve—certainly a combination of qualities in a valve making it second to none other.

The construction is of the best steam bronze, except the reversible disk, which is made of new alloy, the "Powelium" white bronze, a metal as white and non-corrosive as silver, hard, close grained, and will outwear the best gun metal. The disk, having duplicate wearing faces, will last many times longer than the ordinary construction. The disk carrier is so constructed as to protect the upper or unused face of the disk until it is to be reversed when lower face is worn out. Taking the staying qualities of the metal, and the improved construction together, we have a combination in the Powell "White Star" that must commend it to the favorable attention of all valves.

The Disk is attached to Carrier H by a Jamb Nut, which Carrier swivels on the Stem and is made with a projecting flange which protects the upper face of Disk from scale or corrosion while lower face is in service. The Stem D is centrally guided within the Neck N of the Body B by Wing Guides C.

The Disk V is made *double-faced*, and has a short prolongation below each face which serves not only to guide the Disk centrally within the Seat opening, but acts also as a baffle check to the flow of steam just as it moves to or from its Seat, and prevents cutting of the latter.

The Valve Stem D is pierced at P to receive the Lock Bar F when locking the Disk. When the Lock Bar F is not in use it is placed in the Hole P, between the wings of Stem, and as this part of the Stem never leaves the inside bearing surface of the Neck N it is impossible to lose the bar out.

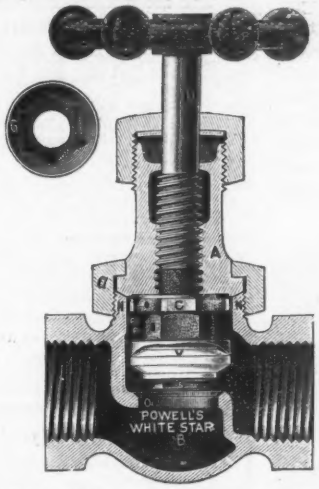
The Bonnet A is cored out at top with a hexagon cavity to ensure a liberal supply of packing material, the packing being

thereby firmly held in place in such a manner that when it is desired to renew the same it remains in the Bonnet instead of the Pack Nut.

The Bonnet A is firmly secured to the cone face of the Neck N by the Coupling Nut A, which ensures a tight joint and also expands the thread of the Neck, thereby greatly increasing the hold of the latter against excessive steam pressure.

The guided construction of the Stem D within the Neck of the body and the lower guides on the Disk which enter the Seat opening, ensures their perfect alignment at all times, greatly prolonging the life of the Valve.

Great care is taken in the construction of these Valves. The metal is distributed just where it is most required, the proportions are symmetrical and the quality of the alloys is compounded to ensure the greatest durability.



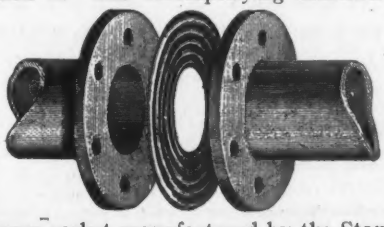
To re-grind the Disk when worn: Release Bonnet A from the Body, withdraw Lock Bar F from Hole P, and insert in the lower Hole P. This locks the Carrier from turning, but leaves it free to oscillate while grinding. Now grasp the Wheel Handle, apply sand and water to the Disk and rotate back and forth as may be required. After a good bearing is obtained, replace Bar F to its former position for future use.

To reverse the Disk, if worn, lock Carrier H by inserting a wire nail through Hole P, grasp the Wheel Handle and use a small wrench or plyers to the Nut S, unscrew it, remove the Disk, reverse it, replace Nut S, screw up tight and grind the Disk to a tight bearing and the Valve will be as good as new The novel simplicity and convenience of this operation will be appreciated by all users of Valves, as no special wrench or vise is needed.

Further particulars can be had from C. J. Ramiar and Company, 518 Arch St., Phila. Pa., or by direct communication with The William Powell Company, Cincinnati, Ohio.

The Improved Copper Gasket

Almost every engineer has had more or less trouble with packing either blowing, or burning out, and such things usually occurs at a time when it is a costly experiment to take down the joint to repack it. The accompanying illustration shows an



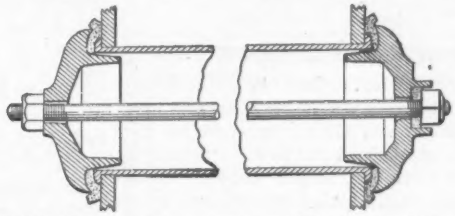
improved copper gasket manufactured by the Standard Gasket Company, of South 36th street, Philadelphia, Pa., This device is warranted neither to burn nor blow out and is certain to make steam tight joints. Considering the saving of time and trouble by using this gasket it would seem to be a cheap investment for steam users.

The Standard Boiler Flue Plug

It is not always convenient to shut down a plant until tubes can be replaced or rolled when they start to leak, but unless a better method is used this becomes necessary when there is not extra boilers. A very efficient remedy for this costly delay is herewith illustrated and described and no doubt it will be welcomed as a friend by many engineers, as it simply and effectively stops the leaks without unusual delay.

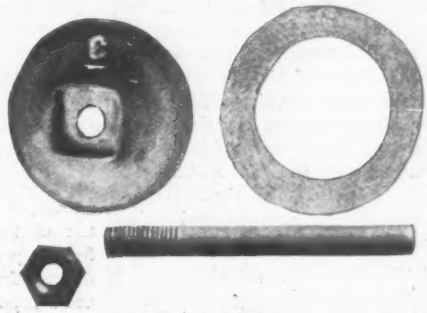
The device consists of two flanged plugs, each with an asbestos gasket packing, saturated in linseed oil to prevent the action of the hot water on them; and one iron connecting rod of suitable lengths and size.

The plug at the left in the drawing is used on the smoke box end of the boiler. A hole is drilled through the center to receive the connecting rod, and the boss is faced on the outside for

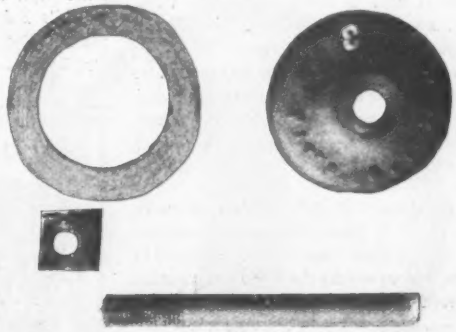


the semi finished nut, so as to secure a tight joint without the use of soft packing between the nut and the plug.

The plug shown at the right is used on the rear end of the boiler. This is also drilled to receive the connecting rod, and on



the outer face of the plug a square recess is provided for the purpose of holding the packing under the nut and at the same



time preventing the latter from turning when both plugs are drawn together from the front end of the boiler.

This plug is manufactured by Reinhold Bettermann, Johnstown, Pa.

TRADE NOTES

The Lee Injector Mfg. Co., have decided to move their factory and offices from Detroit to South Park, Port Huron, Mich., where they will have a large modern and commodious factory with every facility for manufacturing their line of steam specialties in sufficient quantities to supply the large and increasing demand.

The Lackawanna Cylinder Lubricator will lubricate any number of cylinders at one time from a convenient spot on the engine room floor. This is a feature worth considering. The cost is low, too, and the saving in oil, due to a regular and constant feed, is said to be considerable. It holds 5 gallons and therefore does not need to be refilled often,. Further information may be had from Chas. H. Smith, P. O. Box, 478, Wilmington, Del.

A doctor, who advertised himself as a "specialist," was once asked in what diseases he was a specialist. His reply was to the effect that thn patient's disease was always his specialty; iə other words, he admitted that he was a "quack." Its different with Chas. Robson, 8th and Washington Ave., Philadelphia. Mr. Robson is a specialist in grate bars—nothing else. If any of our readers have grate bar troubles they will do well to consult him. The case will be properly treated.

The Wilkinson Mfg. Co., Bridgeport, Pa., are sending out free to readers of the PRACTICAL ENGINEER a very handsome treatise upon coal burning and the value of the 20th Century methods of mechanical stocking. The book is handsomely illustrated, and contains much instructive reading upon this subject. We might state further that Mr. John A. Caldwell has severed his connection with the American Stock Company and is now General Sales Manager for the Wilkinson Companyy, with offices at 45 Broadway, New York City.

On account of their constantly increasing business, the Crandall Packing Co., have found it necessary to have larger quarters in which to conduct the volume of trade emanating from their New York office. They have leased commodious apartments at 123 Liberty St.,where their offices and salesroom will be located. Mr. S. M. Hildreth, Local Manager, will be very glad to welcome their numerous customers at the new location and explain the various packings, which should be interesting to all users of steam goods.

Two large Cross Oil Filters were recently ordered by the U. S. Steel Corporation from the Burt Mfg. Co., Akron, Ohio. This makes 114 Cross Filters now in use by the Steel Corporation in its different mills.

A Handsome Large Catalogue issued, by E. T. Moore Machine & Foundry Co., 2227 Wood St., Philadelphia, will prove of interest to those contemplating the purchase of water tube boilers.

The Standard Steam Specialty Co., manufacturers of the "Utility" Exhaust Muffler, Oil Separator, Return Tank, Pump Governor and Feed Water Heater and other Steam Specialties, have recently taken contracts for 20,000 H. P. of their apparatus. To facilitate manufacturing and be in a position to carry in stock standard sizes of "Utility" Oil Separators from 30 to 10,000 H. P., they have leased the premises 542 and 544 West Broadway from May 1st, which gives them 10,000 square feet of floor space and they invite the trade and friends to call and inspect their new quarters.

The Goheen Manufacturing Co., Canton, Ohio, are sending out a splendidly illustrated catalogue describing the value of their carbonizing coating for iron work of all kinds. The material is used as a protective paint for metals under all conditions. In addition to the advertising matter within the cover there are many handsome illustratious of some of the most imposing bridges ever constructed in America. A copy will be mailed free to readers of the "Practical Engineer" upon application.

The large boiler and engine shops of Reilly & Fearon, at 1164 No. 3d St., Philadelphia, are among the busiest of the kind to be found anywhere, and those who knew the works a few years back would now have difficulty in recognizing it. That which was once large vacant space is now a veritable hive of industry, busy workmen are crowded into every available corner, and the product of the plant for a day is now greater than it formerly was in a month. The firm builds boilers, trucks, engines and does all kinds of repair work.

The Bushnell Improved Coffin Planimeter is ably described and illustrated in a circular just issued by John S. Bushnell Co., 126 Liberty St., New York. Engineers who are interested in indicator practice can secure one of these circulars upon request.

The Stephenson Mfg. Co., of Albany, N. Y., says, that they have recently received an order from J. D. Street & Co., St. Louis, Mo., for one ton of Stephenson's Bar Belt Dressing. If further proof of the merit of the dressing is desired, they will send a testing sample to any one mentioning this journal.

The Cross Oil Filter, manufactured by the Burt Mfg., Co. Akron, Ohio, will be used at the World's Fair., St. Louis, in the present power plant. The Cross Filter was also used by the Omaha, Charleston, Paris and Buffalo Exhibitions.

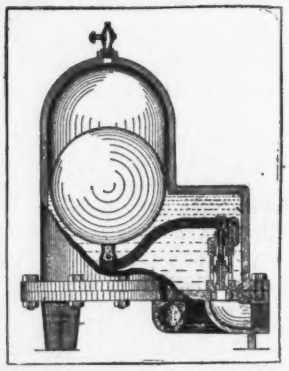
The latest advertisement issued by the manufacturers of Rainbow Sheet Packing, Peerless Piston Packing and Eclipse Gaskets, is a handsome large colored picture representing a race track and athletic grounds, upon which these favorites are shown as winners. The picture is at once artistic and amusing, and a decided ornament to either engine room or office. The company will mail one of these handsome pictures, free to any reader mentioning THE PRACTICAL ENGINEER. Address The Peerless Rubber Mfg. Co., 16 Warren St., New York.

Any of the readers of THE PRACTICAL ENGINEER who are interested in up-to-date oil cans, flue scrapers, or tube cleaners, should get a copy of the catalogue issued by the Gem Mfg. Co., Spruce near 33d St., Pittsburg, Pa.

Schade & Marshall, agents for the Ford Steam Specialties, Harrison Bldg., Philadelphia, have an interesting catalogue, which they will send free to any of our readers who are interested.

IF ENGINEERS will send $1.00 to the address below they will receive two blue prints, with tables and instructions, showing how to set valves and eccentrics on Corliss engines, simple and compound, with one and two eccentrics. JOHN T. LINDSTROM, 214 and 216 S. 3d St., Allentown, Pa.

A GOOD THING



The "FORD" Compound Steam Trap

We want you to take hold of it. Made in 5 sizes. Has large outlet and the largest capacity of any Steam Trap on the market.
Write for full particulars and prices.

Thomas P. Ford Co.
SCHADE & MARSHALL
PHILA. AGENTS
319 HARRISON BUILDING PHILADELPHIA, PA.

A BELT DRESSING WITHOUT A "WEAK SPOT"

Endorsed by over 8000 of the Largest Firms in the World

AS OTHERS SEE IT

AMERICAN CRUSHED STONE CO.
2 Webster Avenue, Chicago, Nov. 7th, 1902.

The Beltine Mfg. Co , 53 55 Jackson Blvd., City.

Gentlemen:—In reply to your inquiry would say that we have used your Beltine for the last three months, after having used every other belt dressing on the market, and it has proved so satisfactory that we do not wish to try any others in future. Yours truly.

AMERICAN CRUSHED STONE CO.
WM. KISSACK, Gen'l Mgr.

A trial will convince the most sceptical, and it is sent on approval. Write us

THE BELTINE MFG. CO.
53 and 55 West Jackson Blvd., CHICAGO

Eastern Agents Wanted

The Kuhlewind Momentum Governor is a mighty interesting and brand new device that will interest most engineers. A new catalogue has just been published, which describes and illustrates it. Copies will be sent free to any of our readers who write to the Anchor Engineering and Machine Co., 105 Pike St., Pittsburg, Pa.

A sample of scale from your boiler sent to the Geo. W. Lord Co., 2238 N. Ninth St., Philadelphia, will bring back a report of analysis without charge. Just fill out the coupon report shown in their advertisement on another page, or make out one like it and send it in with a sample of scale.

John R. Livezey, general agent for Nonpariel Cork Pipe Covering, 1936 Sanson St., Philadelphia, is to be congratulated upon having secured the services of Mr. Clifford P. Williams as general outside salesman. Mr. Williams is one of Philadelphia's best known engineers. He has been chief engineer of Dooner's Hotel for several years past, and has been actively identified with every movement looking to an improvement of the conditions surrounding the profession of stationary engineers during the past decade, being one of the committee of three who had charge of the present engineer's license bill when it was passed at Harrisburg in 1899. He has been an active and valued member of the American Order of Steam Engineers since its beginning, and has passed through all its chairs, having just completed his third term as its Supreme Chief Engineer. His friends in Philadelphia, are legion, and he is fully deserving of the support that will undoubtedly be given him in his new position.

Feed Water Purification has more allurements in it to the engineer than any subject analogous to the steam plant. In recognition of this fact The Pittsburg Feed-Water Heater Co., Carnegie Bldg, Pittsburg, Pa., have compiled a book which thoroughly elucidates their method of treating feed-water. It contains 46 pages of well illustrated matter upon this subject and will make a valuable addition to any engineer's engine-room library. By mentioning THE PRACTICAL ENGINEER they can be had free of cost to those interesed.

The Climax Steam Joint Clamp, the H. H. Steam Trap and other specialties manufactured by Jas. McCrea & Co., 67 West Washington St., Chicago, are now carried in stock by supply houses in nearly every city in the country, so that it is now possible, in case of an accident to a steam pipe, to get a clamp without delay. The firm informs us that their clamp business for the past year has far excelled any previous year since they have been in business, and also that they are doing a phenomenal business with their H. H. steam trap, which is doing good work every where applied. The firm have an interesting catalogue that they will be pleased to send to any of our readers upon request.

The Garlock Packing Co., Palmyra, N. Y., have just published a new and enlarged illustrated catalogue of their high grade, standard packing gaskets, etc., a copy of which they will be pleased to mail any of our readers who will write their nearest office mentioning this paper.

Cut Oil Bills in Half

YOU are throwing away more oil than you are using. This unnecessary expense can be stopped by the use of the . . . . . .

Acme Oil Filter

To prove that this will redeem more oil than any other filter made, we will send it on thirty days free trial. Send for one.

Walter L. Flower & Co.
810 Chemical Building, St. Louis, Mo.

WHEN YOU PAY YOUR OIL BILLS
remember they would only be half as large if you were operating a

CROSS OIL FILTER

If you are inclined to doubt its ability to do this much for you, remember that we take all the risk.

Send for an Oil Filter to-day. Try it 30 days, and if it doesn't save you 50 per cent. in the cost of your oil, send it back at our expense.

At any rate, we want you to read our booklet.

Would you like to duplicate the experience of the firm below?

"The Filters you sent us are saving from $1.00 to $1.50 per day on oil. We use all oil over again, which amounts to about ten gallons per day.
"CUMMER LUMBER CO.,
"Stamps, Ark."

THE BURT MFG. CO., AKRON, O., U.S.A.
Largest Manufacturers of Oil Filters in the World.
Cross Oil Filters carried in stock by the
FAIRBANKS CO.
Sole Agents for Philadelphia

If you have any problem in connection with lubrication which you cannot solve to your own satisfaction, we are willing to put our time against yours to prove that Dixon's Flake Graphite is the solution. Ask for booklet 96-c.

Joseph Dixon Crucible Company, Jersey City, N. J.

Real Engine Insurance

A COCHRANE STEAM SEPARATOR on the steam main leading to your engine is much more than insurance against the damage which is sure to result from water getting into engine cylinders. It is insurance against the accident itself—insurance of the most positive kind. Besides, Cochrane Separators possess supplementary advantages in the way of economies that can be obtained by delivering dry steam to engines. If you are not now getting the economy and safety that follows from the use of dry steam in your engines, the purchase of a Cochrane Separator to be one of the most profitable investments you can make.

SEND FOR CATALOGUE 16-S

HARRISON SAFETY BOILER WORKS
3144 N. 17th St., Philadelphia, Pa.
Manufacturers of COCHRANE FEED-WATER HEATERS.

American Order of Steam Engineers.

ORGANIZED APRIL 27, 1886.

An Order of Engineesr for Engineers and Engineers only.

DECLARATIONS OF PRINCIPLES

Believing that ability will bring its full value in this country, this Order shall at no time take part in strikes, nor in any way interfere between employer and employees. Recognizing their identity of interests, it shall take no part in any project or enterprise that shall interfere with perfect harmony between them; neither shall it be used for political or religious purposes.

These principles shall not be amended or repealed except by unanimous vote of the Order.

Any member who shall be guilty of violating the principles of the Order shall be expelled.

OBJECTS.

First.—To promote a more thorough knowledge in its members of theoretical and practical steam engineering.

Second.—To assist members to obtain employment.

Third.—To help the sick, injured and distressed and bury the dead.

Fourth.—To establish a Widows' and Orphans' Fund.

Fifth.—To help members who shall become incapacitated from following the profession to obtain employment suited to their affliction.

Sixth.—To do our utmost to extend the license law throughout the United States.

Seventh.—To establish schools in which our members may study the highest branches of steam engineering.

MEMBERSHIP.

An applicant for membership must be an engineer between twenty-one and fifty years of age, and must be a white male citizen of the United States, of good moral character and be a believer in the Supreme Being, and be free from all physical infirmities.

He must have had three years' service in an engineering department, or if a machinist, or graduate of a technical institute, then one year's service, in such department, and in localities where engineers are required by law to be licensed, they must have such license, and must satisfy the investigating and examining committees of the council to which he applies as to his character and ability.

LIFE MEMBERSHIP.

Engineers who have passed the age limit may be admitted to life membership. They must possess the same qualifications and pass the same examination as are reqnired in the next proceeding clause: They shall be entitled to all rights and privileges of the Order except they cannot vote on financial questions or for the election of officers or be entitled to any sick or death benefits.

DIRECTORY.

The Publication Committee of "The Practical Engineer" desires that the Corresponding Engineers of all Councils of the American Order of Steam Engineers send the name of their Chief Engineer and their own name and address, together with the time and place of meeting, to the Secretary of the Publication Committee immediately after each election of officers. Address J. C. McDowell, Secretary, in care of "The Practical Engineer," 1215 Filbert Street, Philadelphia.

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Deputy Supreme Chief Engineer, David J. Stayton, No. 513 Searles St., Wilmington.

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Delaware Council, No. 1, meets every Wednesday at S. E. Cor. Fourth and King Sts. Chief Engineer, Harry W. Sherman. Corresponding Engineer, A. E. Deakyne, 406 Lombard St.

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Deputy Supreme Chief Engineer, John W. Angers.

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Jennings Council, No. 2, meets every Saturday evening in American Bank. Chief Engineer, Daniel R. Jones. Corresponding Engineer, R. E. Funk.

MARYLAND.

Deputy Supreme Chief Engineer, A. J. Deidrich, 226 North Caroline St., Baltimore, Md.

BALTIMORE.

Maryland Council, No. 1, meets 2nd and 4th Fridays in Royal Arcanium Hall. Chief Engineer, Geo. Goodwin. Corresponding Engineer, Wm. S. Smith, 533 Sharp St., Baltimore.

Energy Council, No. 2, meets every Wednesday of each month in Bauer Hall, Chesapeake and Elliott Sts. Chief Engineer, T. E. Eaton. Corresponding Engineer, Thos. O. Daneker, 834 East Ave.

MASSACHUSETTS.

Deputy Supreme Chief for Eastern District, W. E. Packard, Whitmann.

BOSTON.

Boston Council, No. 4, meets 2nd and 4th Thursdays of each month, in Templar Hall, 724 Washington St. Chief Engineer, A. R. Abbott. Corresponding Engineer, Phillip Sanford.

ROCKLAND.

Old Colony Council, No. 14, meets 2nd and 4th Saturdays in the American Foresters' Hall. Chief Engineer, Herbert W. Jones. Corresponding Engineer, James K. Sedgwick, Box 333, Rockland, Mass.

NEW JERSEY.

Deputy Supreme Chief, F. O. Garrison, Bridgeton, N. J.

PERTH AMBOY.

Stevens Council, No. 1, meets 3rd Saturday, at Water, near Lafayette St. Chief Engineer, Lawrence Oliver. Corresponding Engineer, James H. White.

CAMDEN.

Camden Council, No. 3, meets every Thursday evening at N. E. Cor. Second and Federal Sts. Chief Engineer, C. H. Harigle. Corresponding Engineer, C. H. Pfeiffer, 571 Berkley St.

ATLANTIC CITY.

Atlantic City, No. 4, meets every Tuesday evening at Merchants, Cor. Atlantic and New York Aves. Chief Engineer, Wm. Fowden. Corresponding Engineer, W. S. Price, Haddon Hall.

BRIDGETON.

Bridgeton Council, No. 5, meets every Friday. Chief Engineer, David Sellers. Corresponding Engineer, Francis O. Garrison, Bridgeton, N. J.

MILLVILLE.

Millville Council, No. 6, meets every Saturday, 7.30 P. M., in G. A. R. Hall, East Main St. Chief Engineer, Geo. Esabel. Corresponding Engineer, Lewis Doughty, 604 Mulberry St.

NEW YORK.

SYRACUSE.

John E. Sweet Council, No. 6, meets Monday, Room 23, Nottingham Block, East Washington St. Chief Engineer, John Cunningham. Corresponding Engineer, S. A. Steel, 311 Orange St.

PENNSYLVANIA.

Grand Chief Engineer, Hiram Trout, 1042 Locust St., Reading, Pa. Deputy Grand Chief for Philadelphia and Delaware Counties, John P. Rickards, 2707 N. Broad St., Philadelphia. Grand Corresponding Engineer, Frederick Markoe, 931 Orianna St., Philadelphia.

Deputy Grand Chief for Western Pennsylvania, A. D. Hamilton, 2025 Forbes St., Pittsburg, Pa.

PHILADELPHIA.

Germantown Council, No. 22, meets every Wednesday evening at Main and Seymour Sts., Germantown. Chief Engineer, L. F. Souders. Corresponding Engineer, Frank MacIndoe, 3519 Ainsley St., Falls of Schuylkill, Philadelphia.

Welcome Council, No. 2, meets every Friday, N. W. Cor. Twelfth St. and Columbia Ave. Chief Engineer, Paul Pieling. Corresponding Engineer, L. D. Woodington, 2428 N. Bancroft St.

Kensington Council, No. 3, meets every Thursday, at A. P. A. Hall, Frankford Ave. and Master St. Chief Engineer, C. W. Leng. Corresponding Engineer, Ernest Ritsert, 2229 Frankford Ave., Philadelphia.

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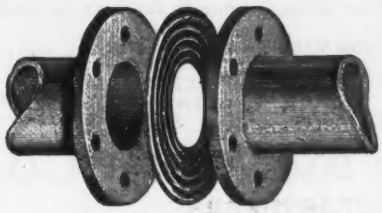

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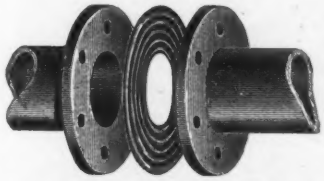

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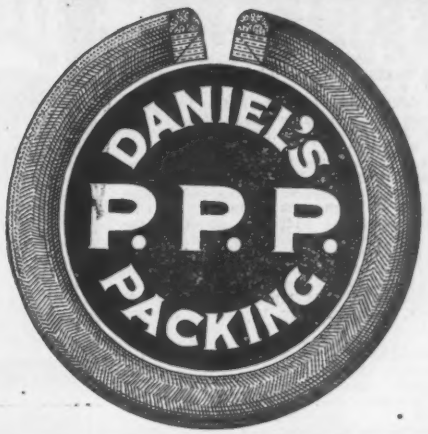

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Southwark Council, No. 4, meets every Monday, at Cor. of Reed and Eighth Sts. Chief Engineer, Joseph Hynes. Corresponding Engineer, J. C. McDowell, 1913 South Eighth St.

Philadelphia Council, No. 7, meets every Wednesday, at Kenny's Hall, N. W. Cor. Broad and Filbert Sts. Chief Engineer, W. G. Richards. Corresponding Engineer, W. S. Wetzler, 3717 Aspen St.

Manayunk Council, No. 9, meets 2nd and 4th Friday evenings in Temperance Hall. Chief Engineer, John Hill. Corresponding Engineer, John Clevenger, 211 Lofty St.

Helping Hand Council, No. 12, meets every Thursday evening at Kensington Ave. and C St. Chief Engineer, Edward Laurence. Corresponding Engineer, Frank McHugh, 2503 Tulip St. All correspondence should be addressed direct to the Council.

Municipal P. F. D. Council, No. 20, of Philadelphia, meets the second Thursday of each month at Odd Fellows' Hall, Third and Brown Sts. Chief Engineer, Daniel Bunting. Corresponding Engineer, Walter Meyers, 1211 North Howard St.

PITTSBURG.

Iron City Council, No. 21, meets every Saturday at Arnfeld Hall, 1119 Penn Ave. Chief Engineer, J. J. Stewart. Corresponding Engineer, Alex. Fraser, Carnegie, Pa.

GIRARDVILLE.

Girard Council, No. 8, meets every Tuesday evening at O'Neill's Hall, Second and Ogden Sts. Chief Engineer, Jacob Weber. Corresponding Engineer, M. J. Carey, Lock Box 214.

ALLENTOWN.

Lehigh Council, No. 15, meets every Wednesday evening at 639 Hamilton St. Chief Engineer, John Durrin. Corresponding Engineer, A. P. Driesbach, 728 Chew St.

POTTSTOWN.

Pottstown Council, No. 14, meets 1st and 3rd Saturday evenings at P. O. S. of A. Hall, Cor. High and Hanover Sts. Chief Engineer, Wm. Rickert. Corresponding Engineer, H. L. Shirey, 362 Cherry St.

READING.

Progress Council, No. 13, meets every Saturday evening at Diebert Hall, Ninth and Penn Sts., Room 4. Chief Engineer, A. B. Hess. Corresponding Engineer, Frank S. Miller, 3 West Franklin St.

CHESTER.

Delaware County Council, No. 6, meets every Wednesday evening in the Carpenter Hall, Sixth and Wall Sts. Chief Engineer, John Canavan. Corresponding Engineer, E. E. McCoy, 2222 West Third St.

YORK.

York Council, No. 16, meets every Wednesday Evening in the Jordan Block. Chief Engineer, A. L. Bair. Corresponding Engineer, Walter H. Long, 23 East Philadelphia St.

HARRISBURG.

Capitol City Council, No. 17, meets every Tuesday evening in Red Men's Hall, Market St., above Second. Chief Engineer, B. H. Shafer. Corresponding Engineer, S. Filson, 1126 Market St.

COLUMBIA.

Columbia Council, No. 18, meets every 1st and 3rd Saturdays, in Odd Fellows' Hall. Chief Engineer, Amos Simmons. Corresponding Enginner, W. J. Courtney, 804 Walnut St.

SUNBURY.

Sunbury Council, No. 19, meets every Monday evening in Zartman's Hall. Chief Engineer, H. E. Culp. Corresponding Engineer, Ed. Schrieber.

WISCONSIN.

Deputy Supreme Chief Engineer, Joseph P. Harris, No. 1611 Clybourn St., Milwaukee.

MILWAUKEE.

Washington Council, No. 1, meets every Saturday at 207 Grand Ave. Chief Engineer, J. B. Chambers. Corresponding Engineer, James A. Rigby, 136 Reed St.

Clifford P. Williams Council, No. 2, meets every Monday evening at Lodge Hall, E. Water St. Chief Engineer, Elmer Towers. Corresponding Engineer, Joseph T. Harris, 1611 Clybourn St.

TENNESSEE.

Deputy Supreme Chief Engineer, John B. Mullen, 826 Central Ave., Nashville.

NASHVILLE.

Enterprise Council, No. 1, meets every Friday evening in the Twin Building on Cedar St. Chief Engineer, J. J. Johnson. Corresponding Engineer, Jno. B. Mullen, 209 Jackson Building.

OREGON.

Deputy Supreme Chief Engineer, Nat. Freese, Grant's Pass, Oregon.

GRANT'S PASS.

Oregon Council, No. 1, meets every 1st and 3rd Saturday in A. O. U. W. Hall, Main St. Chief Engineer, William H. Kenny. Corresponding Engineer, Nat Freese.

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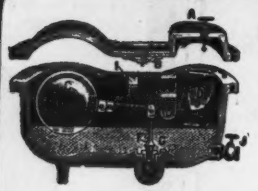
Deputy Supreme Chief Engineer, S. A. Bisbey, care of Cotton Compress and Warehouse Co., Galveston.

GALVESTON.

Galveston Council, No. 1, meets every 2nd and 4th Tuesday evenings at Engineers' Hall, S. W. Cor. Twenty-second and Strand Sts. Chief Engineer, Max Levy. Corresponding Engineer, A. L. Bradford, Union Depot.



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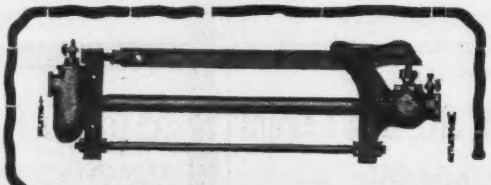

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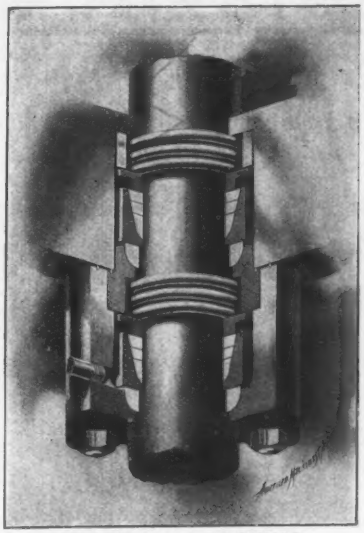

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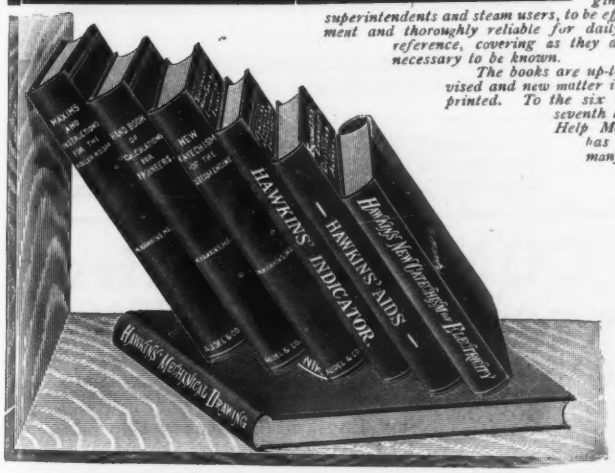

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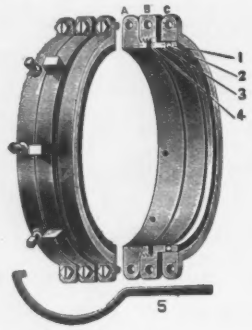

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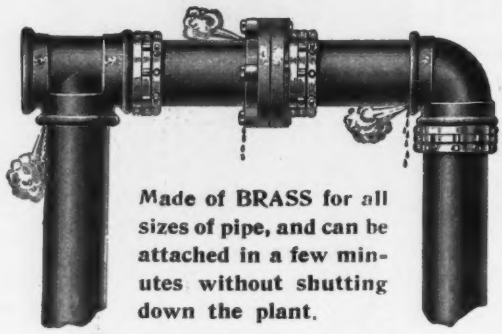

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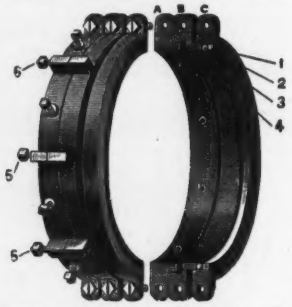

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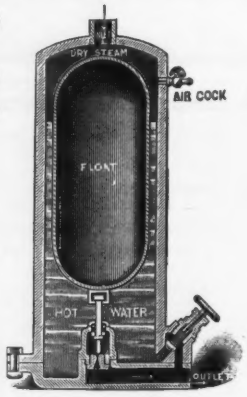

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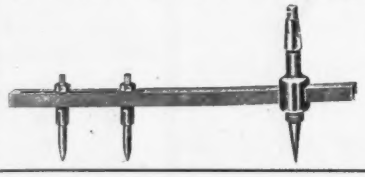

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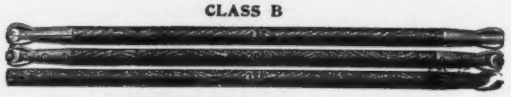

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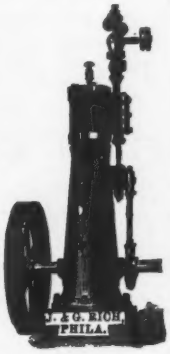

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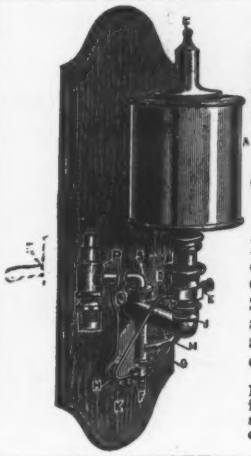

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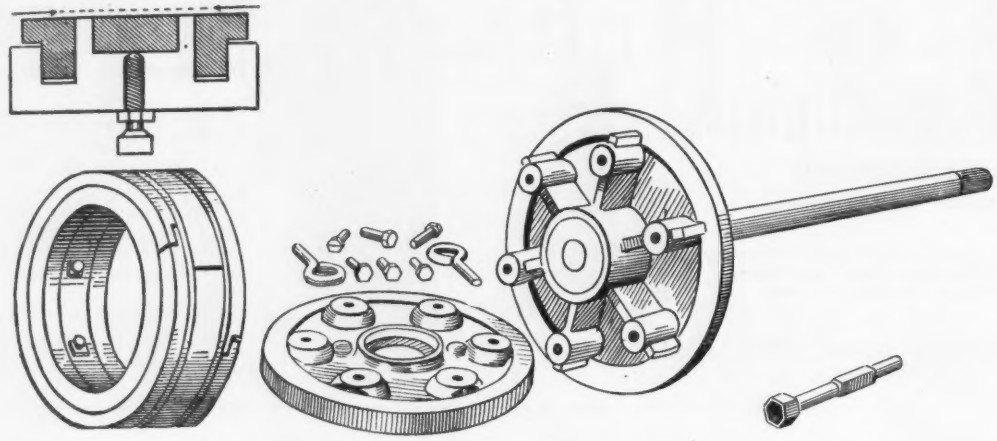
If the bore of the cylinder is not true, have it re-bored and put in our adjustable piston and St. John Self-Adjusting Cylinder Packing, and we will guarantee a perfectly steam tight cylinder.

A very slight leak in the cylinder of an engine making sixty revolutions a minute, running nine hours a day, means a large loss of coal every week, and this means money, as it takes the coal to make the steam, and money to pay for the coal.



The St. John Piston and Packing have stood the test of over fourteen years in actual use, and the practical use of it and the satisfactory results obtained, are the best proofs of its efficiency.

EXTRACTS FROM LETTERS RECEIVED

From T. J. Cleaver, Supt. Chesapeake and Delaware Co.

The St. John Rings are not new to me. I have had them in the Tug Roman about 13 years; they have never leaked in all that time, and the cylinder is as perfect to-day, inside, as the day it was built. We find it takes from 5 to 7 pounds less steam to turn the engine with "St. John Rings" than with those of the old style.

From Carbon Iron and Steel Co., Parryville, Pa.

Since putting your St. John Packing on our engine, we are getting better results from her, and are using 25 per cent. less boiler capacity to do the work.

From the Reading Paper Mill, Reading, Pa.

In reference to the St. John Self-Adjusting Cylinder Packing, it did more than we expected; have stopped one engine and have better power now than we had with the two engines.

First-class engineers want first-class work, as they know this is the only kind of work that pays around an engine, and they also know this is the kind of work turned out by H. B. U. &. Co.

Our specialty is repairs to engines. When you have work of this kind done, have it done right; it pays in the end.

We don't do or recommend cheap work

H. B. UNDERWOOD & CO.

1025 Hamilton Street Philadelphia, Pa.

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LUBRICATING OILS AND GREASES

PEERLESS Boiler Cleaning Compounds

Our First and Last Consideration is QUALITY

408 to 418 VINE ST., PHILADELPHIA

HESS & BARKER

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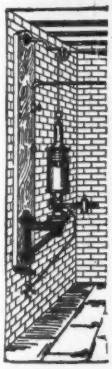

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General Repairs a Specialty Estimates Furnished

Stereotyping Machinery, Wood Working Machinery, Engines, Boilers, Steam Pumps, Special Machinery Built From Plans, Steam Fitting in all its Branches, Shaftings and Hangers Erected, Water Wheels and Pumps.

DYNAMO AND MOTOR COMMUTATORS REPAIRED, IF NECESSARY, WITHOUT REMOVING

We manufacture the

IMPROVED KELLAM DAMPER REGULATOR

Miss Simplicity, the new name given the "Sims" Oil Filter by engineers who are using them.

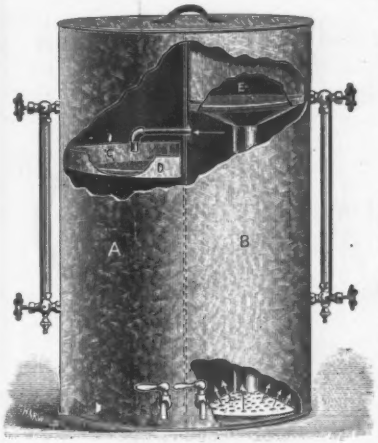
ERIE, PA., January 25, 1903.

THE SIMS CO., CITY.

GENTLEMEN:—Referring to your inquiry, we take pleasure in saying that we have had a Sims Oil Filter in use in our Ice Works for some months.

We had used three other filters prior to placing this one. We find that the "Sims" does better work than either of the others. The matter of cleaning is so small an affair that it is never neglected. The Filter has paid for itself many times since it has been in use.

Truly yours,
THE UNION ICE CO.



Write for Catalogue "E" and learn all about this Filter and the Steam Appliances we manufacture.

SIMS COMPANY, ERIE, PA.

FREE TO ENGINEERS

Engineering Practice and Theory

is a plain, practical, concise book on steam engineering. It contains 184 pages, 5 x 7½ inches, and has *200 Examine Questions*, also an appendix which explains 35 causes for pounding in steam engines.

We will send a copy of this book free, to anyone sending us a club of three yearly subscribers to THE PRACTICAL ENGINEER at Fifty Cents each, or will send a copy of the book, postage paid, to any address, upon receipt of *One Dollar*.

The Practical Engineer

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NUGENT'S Pendulum Dust Proof Crank Pin Center Oiler is Lubricating the Crank Pin of this Engine, which runs 300 revolutions per minutes 144 hours every week.

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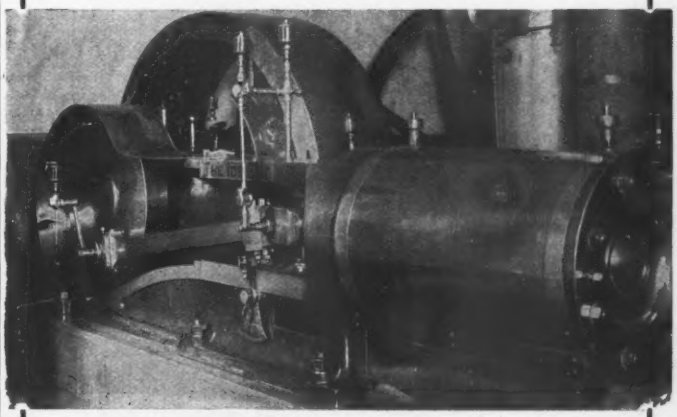
RIMMINGTON BROS., Carlisle, England



NUGENT'S Anti-Packed Dust Proof Telescopic Crosshead Pin Oiler is also on this "High Flyer." We issue a Catalog (a dandy) and a valuable treatise on "How to Oil an Engine," which you can have for the asking,

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WM. W. NUGENT & CO. 20-22 WEST RANDOLPH STREET CHICAGO, U. S. A.

(MENTION THIS PAPER)

SELDEN'S PATENT PACKINGS

made either with **Rubber or Canvas Core** and both **Round** and **Square** in shape. Will give satisfaction on Engine, Pump, Compressor and Valve Rods. Easiest of all packings on your rods.

Brandt's Triple Expansion Gaskets

For Boiler Work and

Brandt's Hard Pump Valves

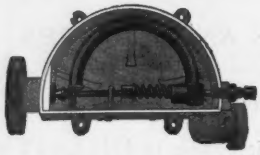
are the very best goods you can use in **High-Pressure** work. Engineers are requested to give the above a trial if they are not now using them.

RANDOLPH BRANDT

Sole Manufacturer and Proprietor

38 CORTLANDT STREET, NEW YORK

Everybody Talks



about saving your steam and coal; but will anybody talk like this?

Thirty days free trial of the Heintz Steam Trap. You either pay our price or what the

Heintz Steam Traps

save you in a year.

Cheaper to pay our price. Send for booklet 4.

William S. Haines Co.

136 South Fourth Street, Philadelphia.

Every engineer who is interested in a PERFECT ENGINE GOVERNOR should get acquainted with

THE KUHLEWIND MOMENTUM GOVERNOR

Manufactured by

THE ANCHOR ENGINEERING and MACHINE CO.

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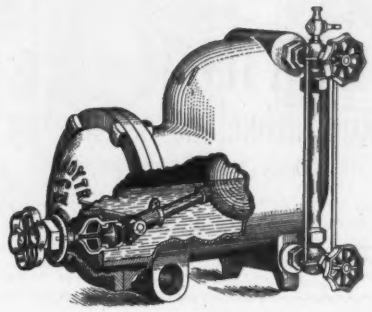
SEND FOR HANDSOME ILLUSTRATED CATALOG



When You Buy a Trap Buy

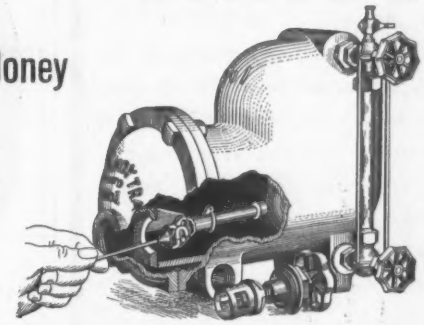
A HANDY TRAP

It has a good habit of doing lots of work without stopping or leaking steam, can you ask any more?

Occasionally a piece of waste or a little sliver of wood that has been left in the pipes comes along—and you know what happens—holds the valve open a little; **there is where we come in handy,**—the gauge glass shows at once—you can clean it all out in a few minutes, **without touching a bolt or joint of any kind.**

It Saves the Engineer Time and Energy—the Boss Money

because it is so easy that it will be done. It will cost you nothing to try if you are in doubt, write for circulars and prices.



THE HANDY TRAP

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We Make a Specialty of REPAIRS to

BOILERS and TANKS

IF YOUR BOILER NEEDS ATTENTION, DON'T DELAY, BUT SEND FOR US

A RIVET IN TIME SAVES NINE

All kinds of Boilers and Tanks Repaired. All kinds of Castings Furnished. Cylinders Bored in position and fitted with Steam Saving and Self Adjusting Piston Rings. Metallic Packing for Piston Rods.

ENGINE REPAIRS **ENGINES INDICATED**

Agents Wanted **Write Us**

Boiler Compounds

Made for all Waters

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574 and 576 West Broadway
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BRUUN-LOWENER PATENT A W S Co.

Settled

The problem of perfect water for boilers is settled once for all when you install the BRUUN-LOWENER apparatus. If the water changes, the apparatus is adapted to the change in a moment; otherwise, it runs on, week after week, taking care of itself, meeting all variations of pressure, absolutely certain and absolutely uniform.

Water can be treated hot or cold.

Does it seem strange that the best water softener on the market should cost less to install than any other?

Write for booklet and full details.

American Water Softener Co.

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Agents: J. A. TAFT & Co.,
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tells how to buy best, how to save money, how to improve methods. Thus $1 may save you $1,000—5c. a copy, $1 a year; Frank H. Knox, Troy, N. Y., and all live news dealers. Send for great clubbing offer.

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McNELLEY'S AMERICAN BOILER COMPOUND

Our compound is the result of years of experiments by an engineer of long experience, assisted by expert chemists.

American Boiler Compound not only completely removes all scale and incrustation in the boiler, but prevents new from forming, and will, if properly used, keep the boiler absolutely clean and free from all forms of corrosion, such as pitting, grooving, honeycombing.

Send Sample of Water and Sample of Scale if Convenient

We will be pleased to hear from engineers who will secure trade for us. When writing for information address

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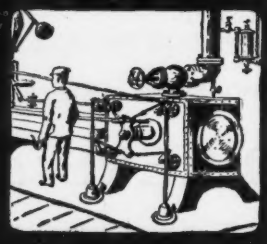
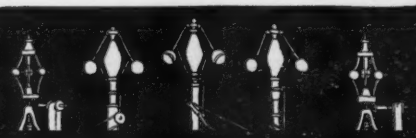


THERE'S NO GOOD REASON why other people can't build overalls as good as the BROTHERHOOD--but they don't. Perhaps it's because many of them work for cheapness alone. I work on principle, for quality. It takes more denim to cut overalls full and easy; more labor to have every point just right and insured under my absolute guarantee. But the quality and principle way of doing business is approved by all fair minded, sensible men; it saves them money in overalls, as in everything else. And the Brotherhood Overall factory is the only one that is Union all through, proprietor included. Insist upon having overalls with the BROTHERHOOD buttons and write me if you can't get them.

H. S. PETERS, B. L. F. 3 B. L. E. 171

Brotherhood Trade Mark Reg. **Overalls,** Dover N. J.

The BROTHERHOOD HIGH BACK APRON is the most comfortable and complete overall made



Registered.

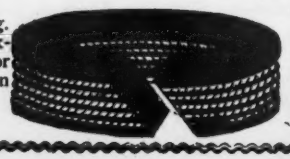
Trade Mark.

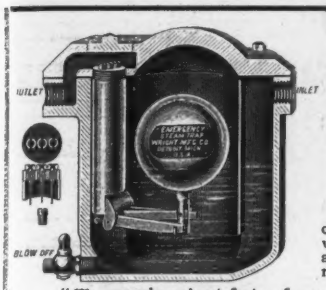
Gould's Steam and Water Packing

THE ORIGINAL RING PATTERN

Self-lubricating, Steam and Water Tight, Less Friction than any other known packikng. **None Genuine Without This Trade Mark Stamped on Wrapper.** All similar packings are imitations. In ordering give exact diameter of Stuffing Box and Piston Rod or Valve Stem. Our Packing is a sure cure for leaky stuffing boxes, whether the motion is rotary or reciprocating.

The Gould Packing Co., East Cambridge, Mass. **Albion Chipman, Treas.**





WRIGHT
Emergency
STEAM TRAPS

Get their strongest endorsements from concerns which have had wide experience with Steam Traps. The Goodyear Tire and Rubber Co., Akron, Ohio, wrote recently:

"We are using about forty of your 'Emergency Steam Traps,' and they are first-class in every particular. They require very little attention, and we are much pleased with them."

The opinions of numerous other prominent plants, full details, etc., gladly mailed on request.

Wright Manufacturing Co
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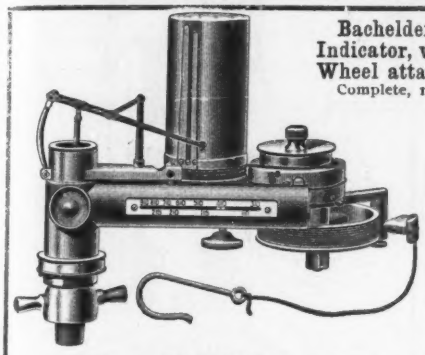


Bachelder Adjustable Spring Indicator, with Ideal Reducing Wheel attached.
Complete, ready for any pressure or stroke.

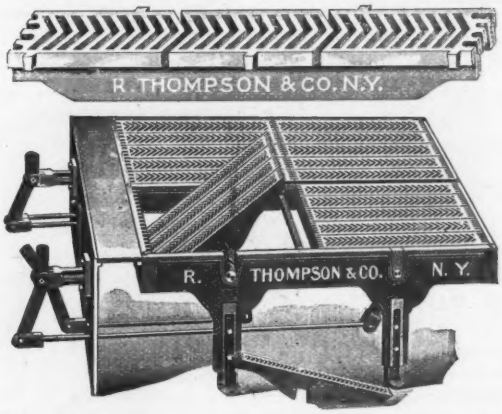
We also manufacture
Bushnell's Improved Planimeter.
Reads both Area and M. E. P. No chance for error.

Bushnell's Cord Take-up saves tangling and breaking of cord. Fits any Indicator.

Soot Sucker Tube Cleaner cleans the tubes without putting steam into them.

JOHN S. BUSHNELL & CO.
126 Liberty Street, NEW YORK, N. Y. Send for Catalogue "A."

GRATE BARS



These Grates are especially adapted to burning the finer grades of fuel, such as Chestnut, Pea, Buckwheat and Screenings. With our **Dumping Grates** a fire can be **cleaned in from three to four minutes** according to size. It is conceded that this is the **only practical way to clean fires thoroughly.**

We have patterns for all size furnaces. Send for booklet "F."

RICHARD THOMPSON & CO.
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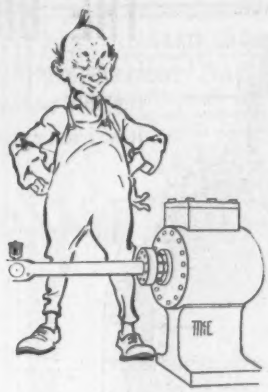


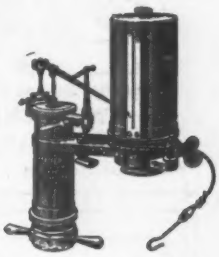
That Cheerful Look

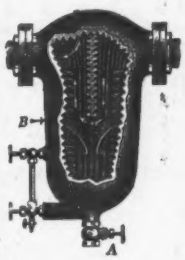
is because he is using **"EUREKA."** His engine runs more smoothly—develops more power—saves coal—don't have to repack so often—saves his time. It's a cheerful friend to have around.

Move Up,

prepare yourself for a better position. There's nothing so helpful as an **INDICATOR,** and none so good as the **ROBERTSON-THOMPSON.**

We will make an attractive price for early orders.





Proofs that Prove

hundreds of duplicate orders from the best engineers.

It's a sure cure for water in engine and oil in boiler. You should know more of the **HINE ELIMINATOR.**

If You Knew

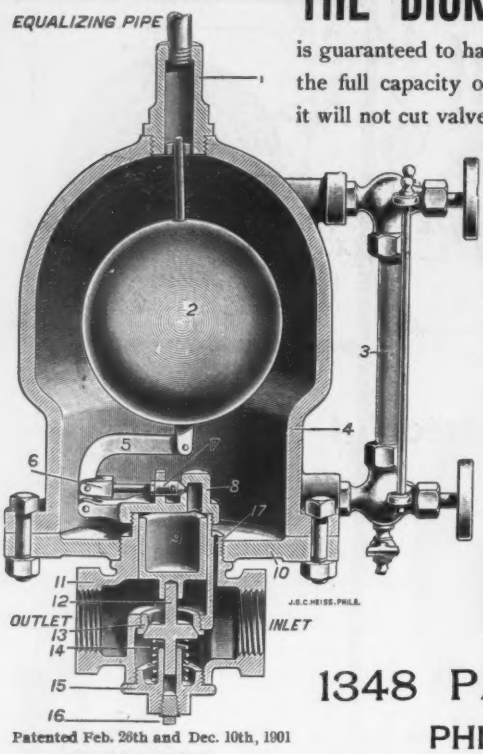
how moderate a price we are making for the **VICTOR REDUCING WHEEL** and **WILLIS PLANIMETER** for quick orders you would not be without either. There's no rigging up or computation as in the old way. Wheel is always ready for any speed or stroke, and the Planimeter gives you at a glance the M. E. P. Let us send you circulars and price.

Jas. L. Robertson & Sons,
204 Fulton Street, New York.

This Trap is Specially Adapted for Separator Work

THE BICKEL FLOAT STEAM TRAP

is guaranteed to handle more water than any trap made. It has the full capacity of pipe connections. It will respond instantly; it will not cut valves, and is **specially adapted for Separators.**



Patented Feb. 26th and Dec. 10th, 1901

THE BICKEL FLOAT STEAM TRAP

For Pressures from 5 to 300 lbs.

The Bickel Thermostatic Steam Trap

is not adapted for Separator use or bleeding steam mains, but is unexcelled for every other service to which a trap can be put. It will respond quicker and last longer than any other expansion trap. Can be set to discharge water at any temperature. Will not cut valves.

Either of these Traps sent to responsible parties on trial.

Fred. L. Bickel

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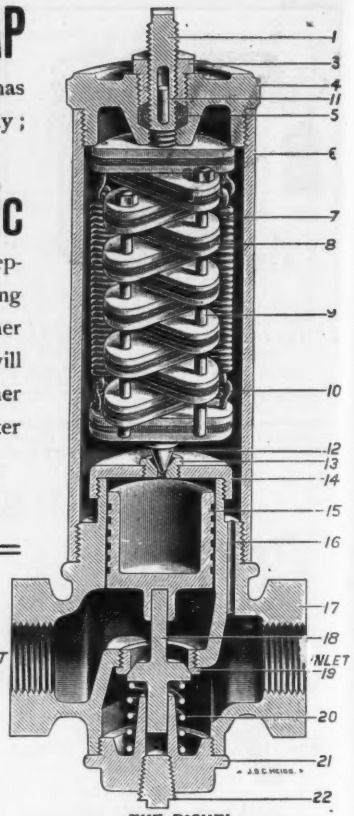
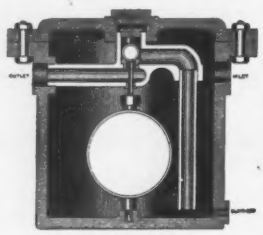


THE BICKEL THERMOSTATIC STEAM TRAP

For Pressure from 5 to 300 lbs.



LINDSTROM TRAP

WHAT! A NEW STEAM TRAP?

YES! One which is much simpler than all the rest.

FIRST:—The Ball Valve being in the steam chamber and away from grit and sediments. SECOND:—Every time the valve opens the ball changes position, and there being such a large valve surface the wear from contact with the seat is very slight. THIRD:—The cover having ground joints, no packing is required. FOURTH:—No steam can escape, the discharge pipe is concealed under water.

Cylinders rebored in their present positions from 4 inches to 76 inches in diameter.

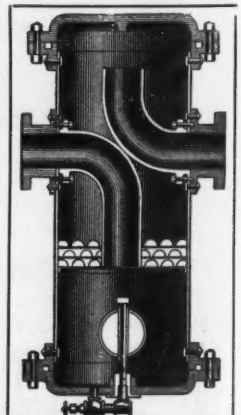
STEAM SEPARATOR FOR INTERIOR OF BOILER

JOHN T. LINDSTROM

Machinist and Engineer

Office and Works, 214 and 216 South Third St.

ALLENTOWN, PA.



STEAM AND OIL SEPARATOR

Every Engineer

who studies his employer's interests—also his own—will appreciate the value and economy in

Wisconsin Flake Graphite Lubricant

It absolutely obviates all friction.
Sample for the asking.

WISCONSIN GRAPHITE CO.
North Side, Pittsburg, Pa.

GARLOCK PACKINGS

HIGH GRADE

For Steam, Water, Ammonia, Hydraulic, Etc.

Are the Standard the World Over

Send for Catalogue and Samples

The Garlock Packing Co

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Main Offices and Factories
PALMYRA, N. Y. HAMBURG, GER.

Austin Steam Separator Satisfaction
is known to over 18,000 Steam Users
Shall we send Catalog?

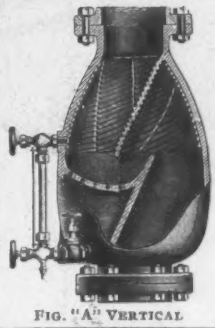

FIG. "A" VERTICAL

Thirty days' trial without expense to you is our guarantee

Austin Separator Co.
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Detroit Mich., U. S. A.

HARTFORD STEAM BOILER INSPECTION AND INSURANCE CO.
HARTFORD, CONN.

RED SEAL BOILER COMPOUND

RED SEAL BOILER COMPOUND

WILL REMOVE SCALE AND GREASE FROM STEAM BOILERS

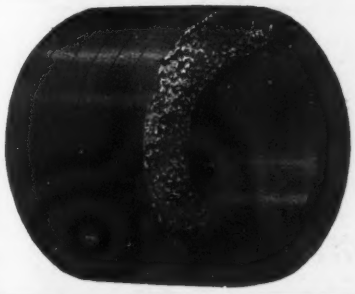
MANUFACTURED BY

THE CHERRY CHEMICAL CO.

OLIVER BRADEN, Manager

Office: 1215 Filbert Street, - - Philadelphia, Pa.

Circulars, Prices and Directions Furnished on Application.



A GOLD MINE

Did it ever occur to you that it is not always necessary to go into the far west to hunt for precious metal to make a fortune? Why you are in a position to make a small or large fortune for the very employers you are working for, if you study their interests, then try and convince them of the value of **Larkin's Self-Lubricating Metallic Packing.**

Let us send you some on trial so that you can demonstrate to them how they can save money by getting a reliable packing.

There are Thousands of Dollars thrown away annually on packing, but there'll come a time some day.

Now is the Time.
Strike while the iron's hot.

Penna. Electrical and Railway Supply Co.
GENERAL SALES AGENTS
PITTSBURG, PENNA.

Watt's High Grade Packings

ALL STANDARD STYLES

Ring and Spiral Packing, made in the same style and sizes as others, but made for service, and at a moderate price.

We manufacture various other good things for engineers too. If you would like to have our catalogues, just drop us a card.

JOHN M. WATT'S SONS, 123 South Second Street, Philadelphia, Pa.
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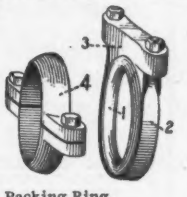
Manufacturers. Also Keystone Metal Polish.



1 Packing Ring.
2 The Flexible Yoke.
3 Cross Head.
4 Split Collar, which keeps the packing in place.

IF you have a leaky joint dripping water over valuable property, use one of **SMITH'S CLAMPS** and it will make a permanent repair.

It has no equal for simplicity, durability and low cost.

If your leak is in an inaccessible position, the use of our clamp will prevent having to tear out the piping. The illustration will tell the rest.

This Clamp is particularly adapted to close pipe connections, as it occupies less space than any other Pipe Clamp manufactured, and is cheaper, too.

In ordering, state size of pipe and for what it is used. Write for price list.
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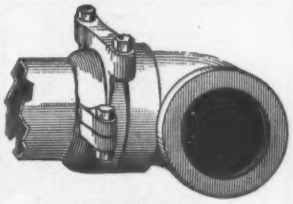

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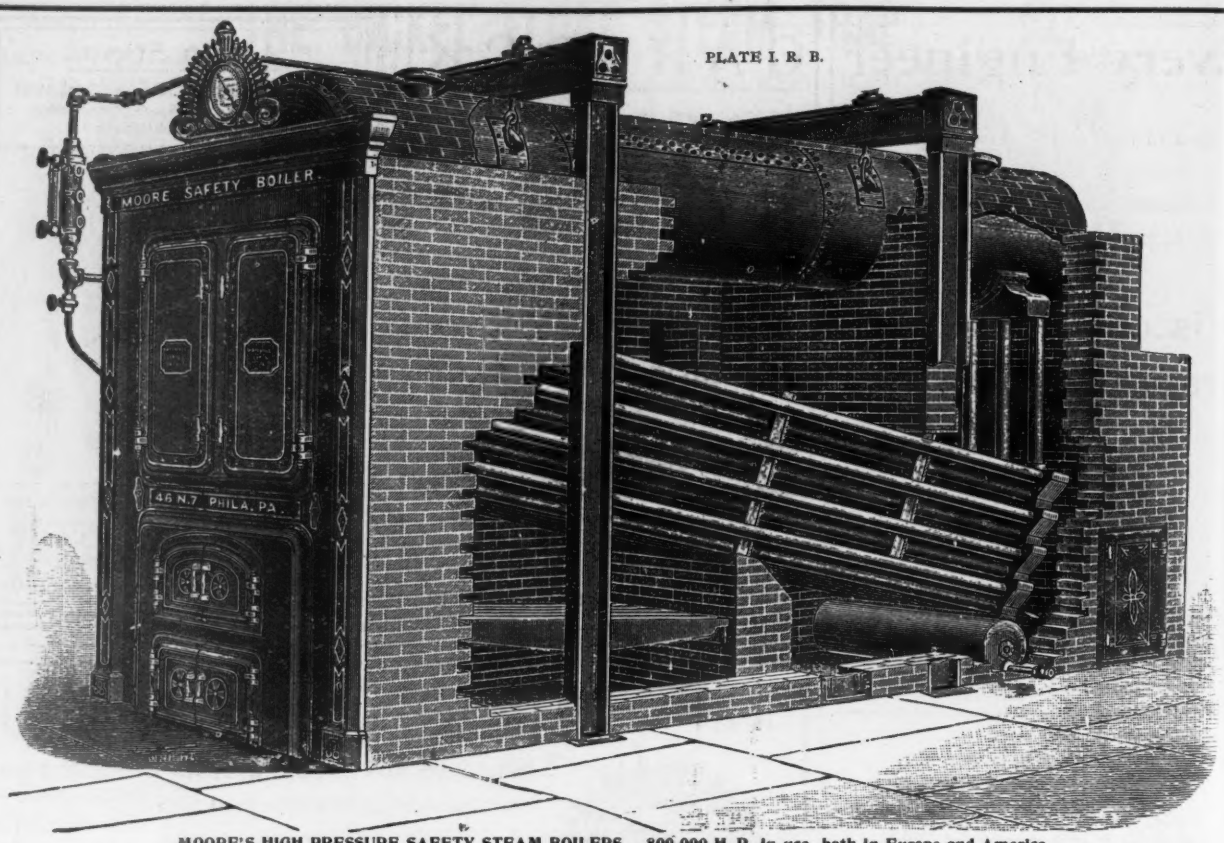

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Repairs of Water Tubes. Boilers of all types a specialty. We have special tools for this purpose.
We keep constantly on hand ready for shipment 1000 horse-power. There can be no delay. **Send for Catalogue.**

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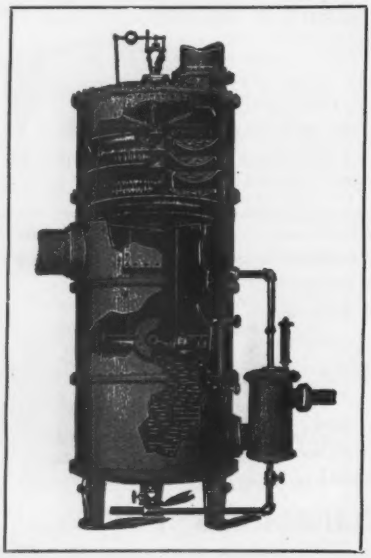

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This heater will accomplish all an exhaust heater can accomplish. It will save its cost in coal within a few months, and will furnish pure water to the boilers.

Ten years' experience has proven our method of separating the oil and other impurities from the feed water—to be correct; we positively take out all impurities that are precipitated, at a temperature of 210° to 212°.

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The OTIS Tubular Feed Water Heater, Oil Separator and Purifier

with Seamless Brass Tubes

Guaranteed

To heat the feed water to the boiling point (210 or 212 degrees) with the exhaust steam without causing any back pressure, **also to extract the oil from the exhaust,** so that the exhaust steam after being passed through the heater can be used for heating purposes, and the water of condensation for the heating system be returned to the boiler without the additional expense of an eliminator..

A Liberal Offer

If this heater fails to give satisfaction in every respect, we pay freight, cartage, etc., both ways.

The Stewart Heater Co.

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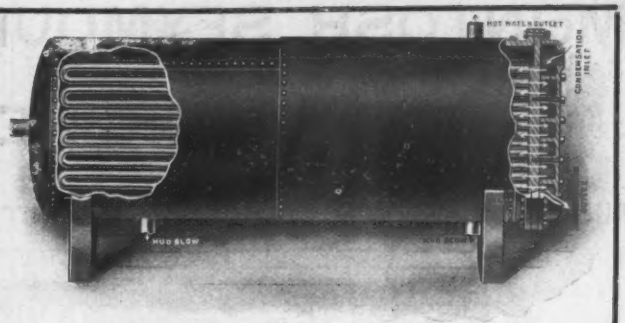

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The Davis Triplex Power Pump

is a perfect type of the vertical triplex belt driven pump.

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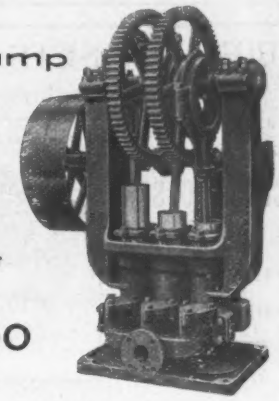

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Manufacturers of

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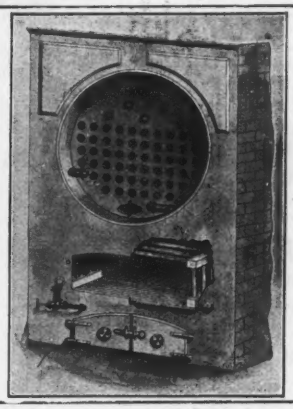
Lamprey Protective Arch Plates

Protect your boiler fronts from burning out, preserve the brick work, save fuel, and increase the efficiency of your boiler, by giving additional heating surface. Save their cost in repairs alone.



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WATER-TUBE AND STEAM-TUBE

Cast Iron or Steel Shells. "∩" Shaped Seamless Drawn Brass Tubes

WE BUILD HEATERS FOR EVERY PURPOSE AND CONDITION

THE KELLEY PATENT

Improved Berryman Water Tube Feed Water Heater and Purifier

A thoroughly up-to date, reliable and efficient heater. Made to stand the highest pressure; and so constructed as to be utterly indestructible by the heaviest boiler it is possible to carry. Write for catalogue.

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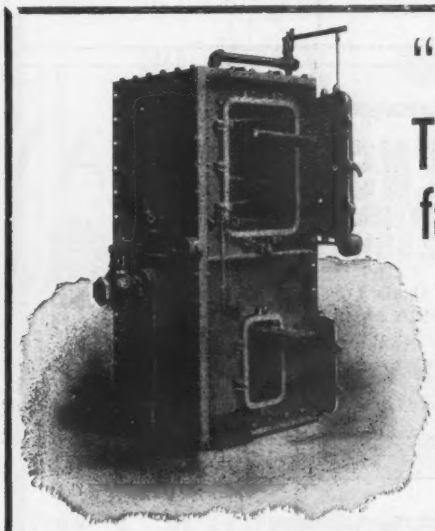

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This familiar saying describes one of the most important of the many advantages of

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The engine exhaust is not all passed through the heater, and thus only the steam necessary to heat the feed-water is used. The "no thoroughfare" feature is the cause of the great economy of these heaters. Write for our catalogue.

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FIFTEEN SETS IN USE BY ONE COMPANY

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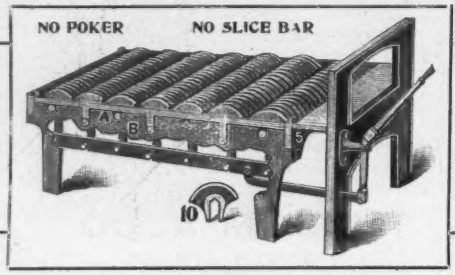

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A Pull on the Chain Does it.
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EFFICIENCY TESTS OF BOILERS
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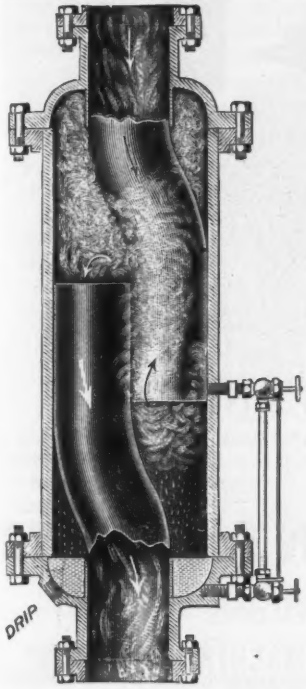
The Stilwell Straight Way Steam Receiver Separator



furnishes dry steam, and with receiver capacity four times the area of inlet, furnishes a larger volume of dry steam at its greatest efficiency at smallest working costs, to draw on than any other article for the purpose in the market, and makes possible the gain that comes from using dry steam.

Made in Vertical and Horizontal patterns.

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THE STILWELL MANUFACTURING AND STEAM SPECIALTY CO.

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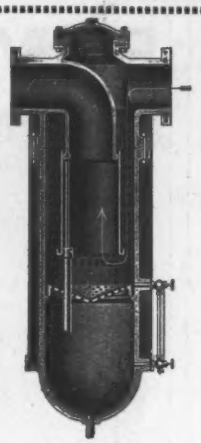

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Of little gutters are provided in **Sweet's Separator** for conducting the oil and water from the steam current and not a drop can get back. This is only one of many reasons why 50 per cent. of them are sold on duplicate orders.

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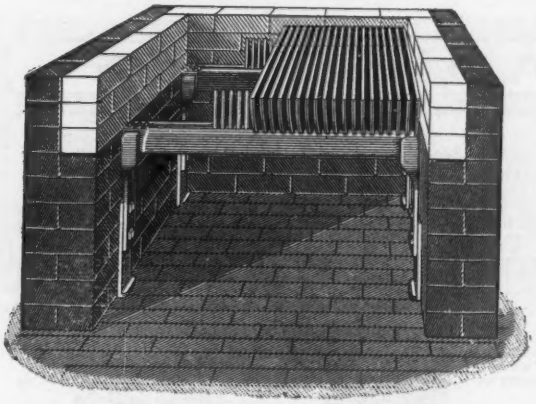
WE MAKE ALL TYPES OF

GRATE BARS

But This is the Best and Cheapest



The Longest-lived Grate Bar That Ever Lived.

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PATENTED

THE ONLY GRATE WITH ADJUSTABLE FRAME.

THE ONLY GRATE WITH LOOSE TEETH BETWEEN THE BARS.

We wish to call your attention to a few important points in our new Furnace Grates.

The adjustable supporting frame, not coming in contact with the brick-work, saves the walls from getting loose, and can be adjusted to any height desired. The perforated supporting cross bar has less obstruction to a free circulation of air than any other Cross Bar made. The movable teeth between the Grate bars can easily be changed at any time, so as to give an air space between the bars that is desired to accommodate any size of fuel; the Movable Teeth also give the bars more freedom to expand and contract, thereby the bars are less liable to warp.

The American Grate Bars have given satisfaction where others have failed. Are made and for sale only by us; other parties have no right to make or sell them.

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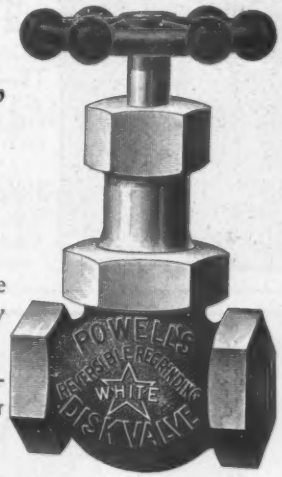

have a longer life and are easier to repair than any valve made.

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Requires LESS steam than any other cleaner.
Will positively clean BETTER than scraper or brush.
Will clean ANY length tube.
In operation is EQUALLY balanced, insuring NO back pressure against operator.
Is the LIGHTEST and EASIEST cleaner to handle.
Has NO working parts.
Its force is tremendous.

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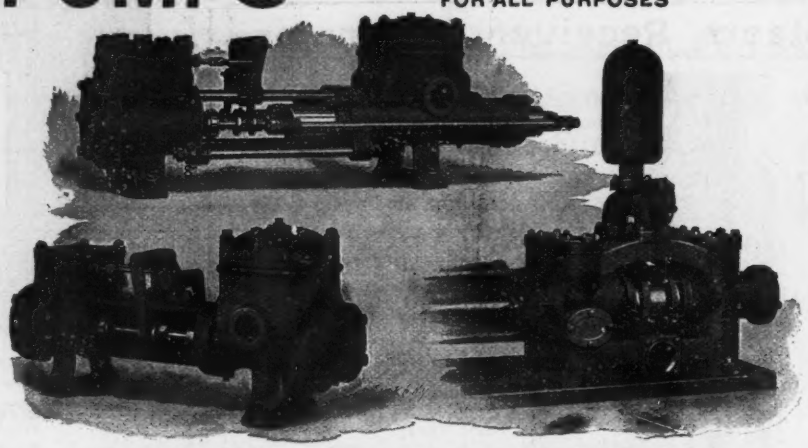

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if not properly done, in any plant, will cause the engineer a great deal of trouble, and his employer unnecessary expense. Many years of practical experience and a force of competent assistants enables me to guarantee absolute satisfaction.

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Wherein any other Injector excels the U. S., and we call attention to the following good things about it:

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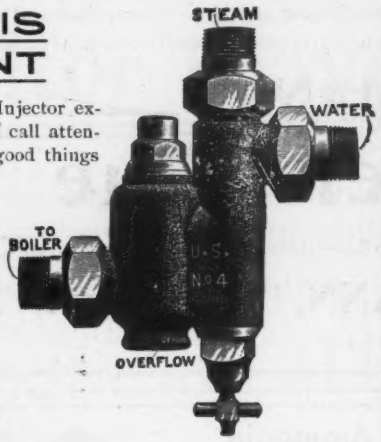

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A traction or portable engine may be run over rocks, stumps, or into ditches, but the Injector will not stop working as long as the suction pipe or hose is under water.

Every Injector is carefully inspected and tested before leaving the factory, to see that it is perfect.

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HALF THE USUAL PRICE

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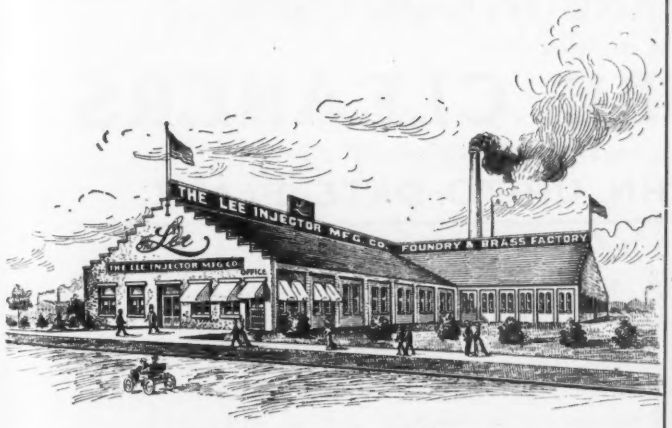

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Bring Your Boiler Room Up To Date

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The AUTO-POSITIVE

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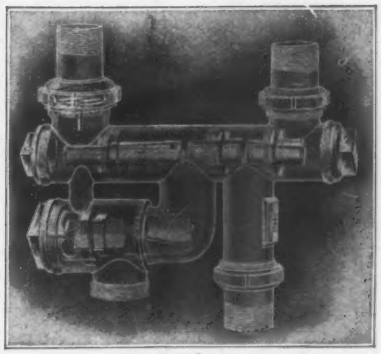

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Only Five Working Parts

Range 20 to 200 lbs. Steam
Lifts Water 22 Feet
Handles Hot Water at 140 Deg.

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Largest Injector Manufacturers in the World.

BOILER TUBES will leak sooner or later, and unpleasant as it is to be surprised and annoyed by a leaking tube, you can't help smiling when you see how easily the trouble is overcome by using

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All Leading Steam Supply Houses have to have them, if yours don't, write to

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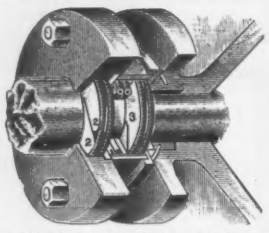

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Outside Type

It Holds Ammonia

without causing any friction, gives the engineer no trouble after once put on. Did you know that

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would do this? An engineer writes: "The same rods that are now working successfully cost us a good many hundred dollars last year in losses of oil, ammonia and cost of soft packing." Wouldn't you like to try it? Costs you nothing. We guarantee satisfaction or accept no pay.

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Will be interested in this letter about

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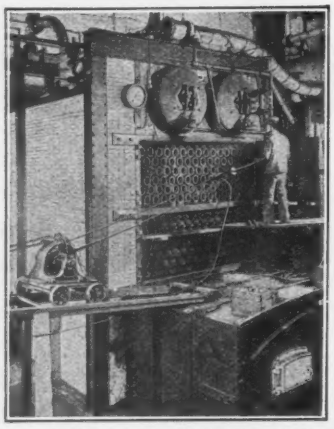

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OFFICE OF PITTSBURG PLATE GLASS CO.

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Springfield, Ohio.

GENTLEMEN:—Your Weinland Mechanical Tube Cleaner which you have installed here in our Elwood plant, is giving entire satisfaction with the work it is doing.

We have removed, approximately, about 50 bu. of scale from one of our Babcock & Wilcox boilers of about 126 tubes, 18 feet long. Our scale would average in some places in the tubes from ¾ inch to ⅞ inch thick. This machine has removed that scale successfully, both in time and labor.

We have tried in our plant about all the devices that are on the market in the way of Mechanical Cleaners, and we find that this Weinland Cleaner will do from 50 to 75 per cent. more work, with the same per cent. less of repairs than anything we have ever had.

We accepted this machine after it had been given a thorough test, and are satisfied with all its details. Yours respectfully,

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Pittsburg Plate Glass Co., Elwood, Ind.

NOTE! CONDITION OF SCALE—Most Cleaners QUIT in HARD SCALE.
TIME OF CLEANING } These are vital points in which THE WEINLAND EXCELS ALL OTHERS.
COST FOR REPAIRS }

We make ALL KINDS OF CLEANERS, including OUR IMPROVED TURBINE with special coupling; also Hand Cleaners.
☞ Write us about Boiler Cleaning. We are experts in that line. Had Twenty Years' Experience—"KNOW HOW." ☜

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Monitor Expansion Packing

is constructed on the best mechanical principles; it is composed of two triangular wedges of Tuck's with rubber cushions at either end, and a rubber strip diagonally through the centre.

THE KING OF ALL PISTON PACKINGS

The wedges work next to the rod; the rubber cushions form gaskets.

The diagonal strip allows the wedges to expand with perfect freedom.

PREVENTS WEAR ON GOOD RODS

It responds to the slightest pressure and instantly accommodates itself to any irregularities or vibrations of the rod; it holds water or steam equally well.

COUNTERACTS WEAR ON BAD RODS

It is cheaper than any other packings, because it lasts longer and does the work better and with less friction than any other on the market.

In 5 and 10 lb. boxes, or reels of 50 and 100 lbs.
In sizes from $\frac{5}{16}$ inch to 3 inches.

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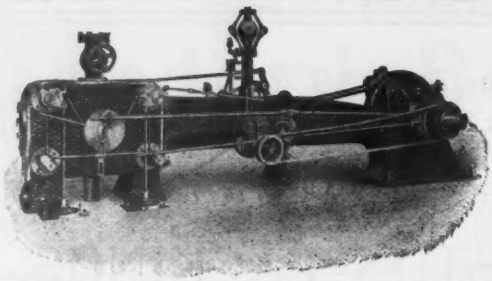

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THROUGH FIRE AND WATER

Chicago, Ill., October 14, 1902.

ATLAS ENGINE WORKS, Indianapolis, Ind.

DEAR SIRS:—In reply to your letter, would say that I have handled your engine for fifteen years, and never had to shut down one day for repairs, and furthermore, it went through a big fire and was under water for three weeks, and when it was cleaned up it did its work the same as if nothing happened. There was not ten cents worth of repairs done on it in fifteen years, and it is good for another ten or more years. This is an automatic 8 x 14 cut-off engine, and it stands at 219 Fulton St., Chicago, Ill. Yours truly,

ISAAC ABRAHAMSEN,
395 N. 57th Avenue.

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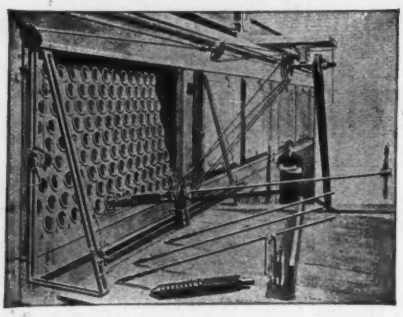

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does the same for Smoke Flue Boilers.

We also make **Gem Oilers,** Patent or Plain, **Torches and Heavy Brazed Steel Oilers, Flexible Shafting.**

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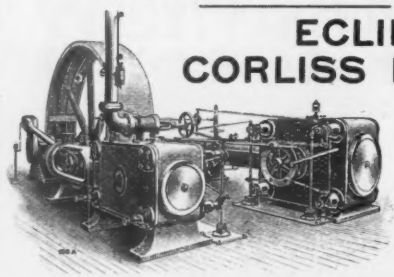

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Plain Corliss Engines, Cross and Tandem Compound, Vertical Corliss Engines.

Corliss Engines of any type, 40 to 2000 horse-power, specially adapted for electric railway work and lighting for factories, mills and general work. Best regulation and economy guaranteed. Also builders of Steam Boilers. We solicit the furnishing of steam plants complete, including everything. Send for our **Corliss Engine Pamphlet** and list of references.

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We furnish complete plants for ice-making and refrigeration for Breweries, Packing Houses, Cold Storage, etc. All refrigerating capacities, from 2 to 300 tons; ice-making plants from 1 to 1000 tons per day. We publish a book describing Ice-Making and Refrigeration, which will be sent to intending purchasers.

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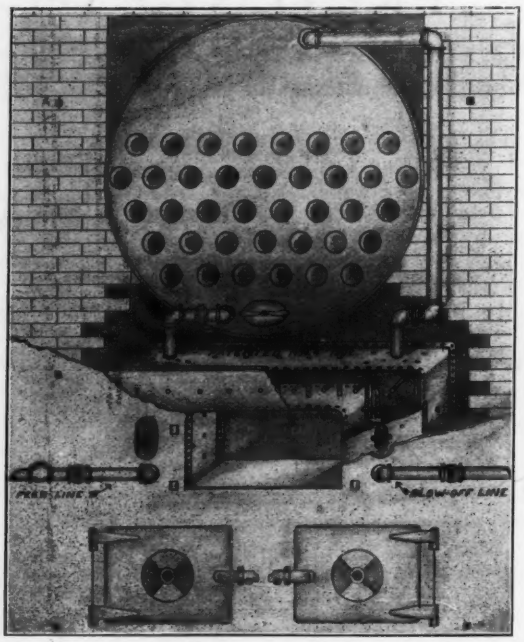

Saves the need of renewing brick arch; lasts as long as the boiler; increases capacity; does the work of a feed-water heater, and saves its cost in coal in a few weeks. You can't afford to be without it.

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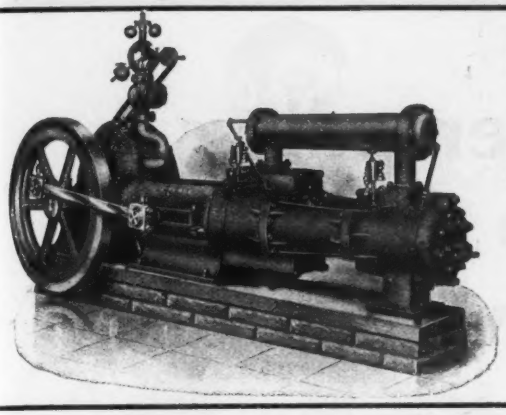

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Remedies to Suit Every Case

We have no fixed boiler compound. We analyze the scale from your boiler and thus find out just what the particular water you use requires to make it suitable for use in a boiler. With this information in our hands, we make a special compound which will keep your boiler free from scale. This will decrease the cost of fuel and increase the efficiency of your boiler.

The Analysis is Free

We also give you a certificate of analysis. There are no "ifs" about it, it is not even conditional upon your purchasing some of our chemicals.

Fill out the coupon, giving data requested thereon, and send us a sample of the scale from your boiler whether you intend purchasing or not. If you send the scale under separate cover be sure to put your name and address upon it.

Don't Delay—Do It To-day

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Number of boilers in use.....

Capacity of each boiler.....

Frequency of cleaning boilers.....

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Boilers are used about..... hours out of the 24.

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We want to convince every engineer that KEYSTONE GREASE is the best lubricant in the world. In order to do this we will, for a limited time, send a

Large Sample and Brass Grease Cup FREE

You will be money ahead if you investigate this.

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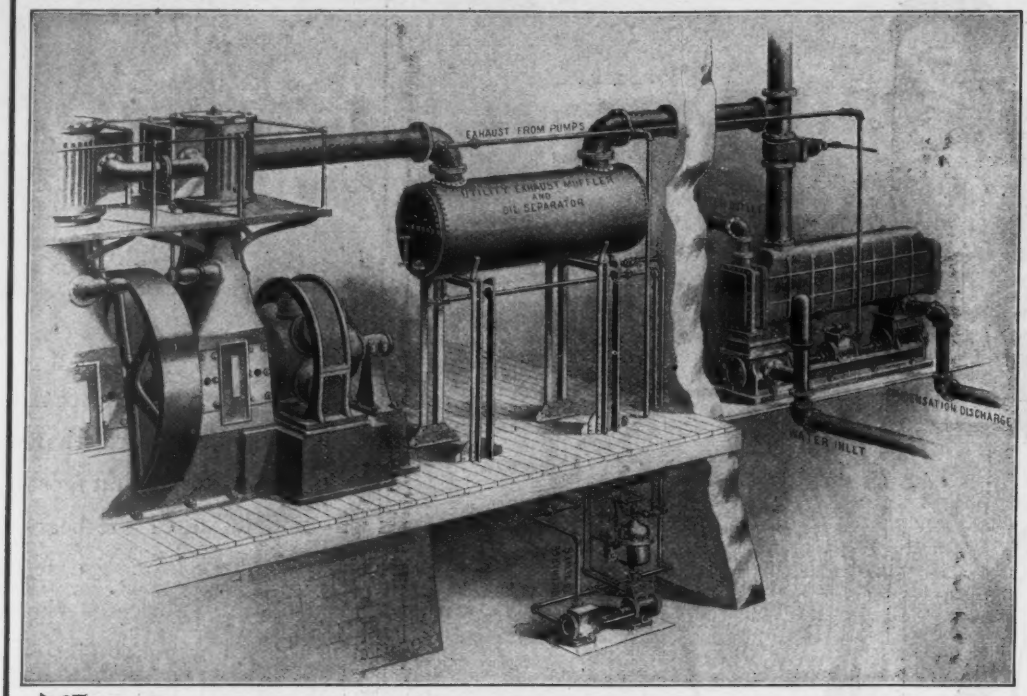

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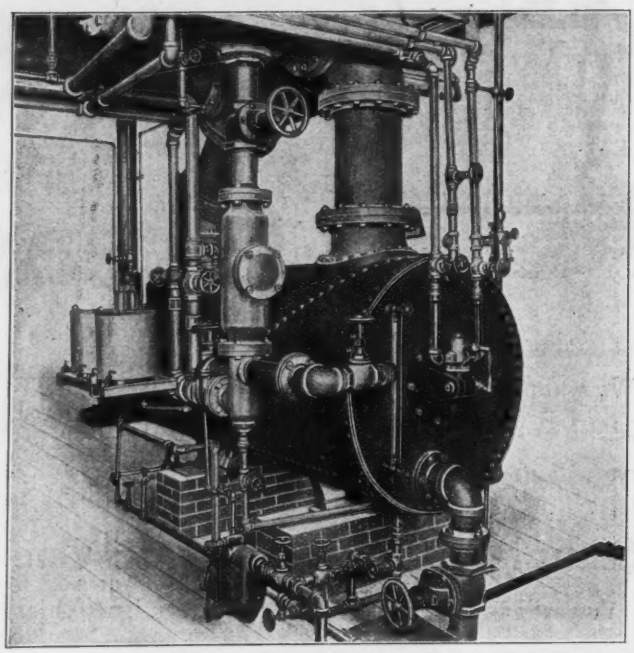

Our **GUARANTEE** is based on the **CHEMICAL ANALYSIS** of the condensed exhaust steam **BEFORE** and **AFTER** passing through our device **WHICH IS POSITIVE PROOF.** We were the first on the market to show such a test and are always pleased to do it in any of the hundreds of **"UTILITY"** installations.

Send for booklet of testimonials. **Our customers talk for us.**

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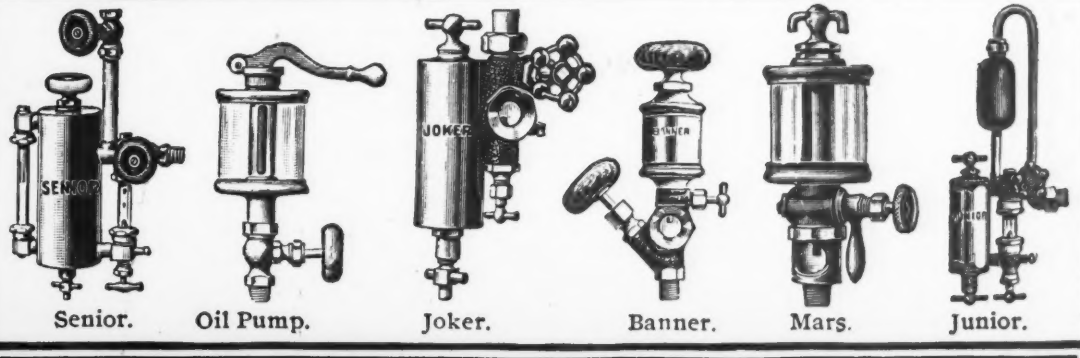

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Use Jenkins '96 Sheet Packing on the worst joint you have, and if it is not what we claim we will refund the money.

JENKINS '96 PACKING has stood the most crucial tests under all conditions of service with steam, oils, acids, ammonia and the like, and in no case has it failed to make a perfect joint when properly applied. Can be placed in a joint either hot or cold, and will make joint instantly. Full steam pressure can be turned on at once when joint is made, it does not require to be followed up and will not blow out. It vulcanizes in place and forms a compound that will not rot or burn out, but will last as long as the metals which hold it. It joins with rough surfaces equally as well as when they are faced. **Jenkins Standard '96 Packing** weighs less than most joint packings. When compared with equal sizes of other packings sold at a lower price per pound, it will be found to cost less per square yard.

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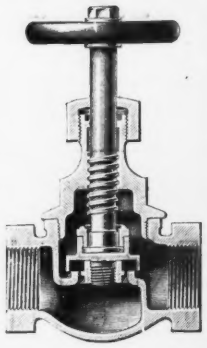

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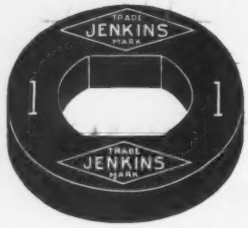

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For mining and high-pressure service, also for elevator pumps, Jenkins Brothers' No. 88 Pump Valves are in use under 450 pounds pressure, and are proving themselves equal to every requirement.

We also manufacture a fine grade of Soft Rubber Valves for cold water and air service.

When ordering valves please state for what purpose you desire to use them.

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